ITALIAN EXPEDITIONS TO THE KARAKORUM (K²) AND HINDU KUSH

Prof. A. DESIO Leader

IV - PALEONTOLOGY - ZOOLOGY - BOTANY

Volume 2

FOSSILS OF NORTH-EAST AFGHANISTAN

ITALIAN EXPEDITIONS TO THE KARAKORUM (K^2) AND HINDU KUSH

Prof. ARDITO DESIO Leader

SCIENTIFIC REPORTS

I

Geography

II

Geophysics

III

Geology - Petrology

IV

Paleontology - Zoology - Botany

V

Prehistory - Anthropology

UNDER THE AUSPICES OF THE
ITALIAN NATIONAL COUNCIL OF RESEARCH

E. J. BRILL - LEIDEN

ITALIAN EXPEDITIONS TO THE KARAKORUM (K^2) AND HINDU KUSH

Prof. ARDITO DESIO Leader

SCIENTIFIC REPORTS

IV Paleontology - Zoology - Botany

Volume 2

FOSSILS OF NORTH-EAST AFGHANISTAN

CARBONIFEROUS FOSSILS

by

A. VON SCHOUPPÉ

TRIASSIC FOSSILS

by

P.D.W. BARNARD

JURASSIC FOSSILS

by

C. ROSSI RONCHETTI

CRETACEOUS AND PALEOGENE FOSSILS

by

A. BERIZZI QUARTO DI PALO and I. PREMOLI SILVA

E. J. BRILL - LEIDEN

1970

PRINTED IN ITALY
ARTI GRAFICHE LA CITTADELLA
PIEVE DEL CAIRO (PAVIA)

PREFACE

The paleontological contributions contained in the present volume represent one of the results of the scientific expedition which operated in Badakhshan and the surrounding countries during the summer of 1961 under the leadership of Professor Ardito Desio, director of the Institute of Geology of the University of Milan (Italy).

The 1961 expedition was preceded by a preliminary journey on the part of A. Desio in 1955 and by a visit to Kabul during the autumn of 1954, after the conquest of K^2 (8611 m). The purpose of the 1961 campaign was the geological and the geophysical exploration of the Wakhan territory, situated between Hindu Kush and Pamir, and the extension westwards of the geophysical observations. The leader was accompanied by Professor Antonio Marussi (geophysicist) of the Trieste University and two assistents (Dr. Giorgio Pasquaré and Dr. Ercole Martina) and by an Afghan geologist (Mr. Ajruddin).

While the geophysical programm was more or less completely carried out, the geological one was changed at the last moment because the expedition was not permitted to visit Wakhan.

The nearest area was central Badakhshan, to the west of Wakhan, and here the geological investigation took place. To be exact we geologically surveyed the area enclosed between Shiwa lake, Zebak, Jurm, Keshem, Taliqan, Kokcha river and Faydzabad (fig. 1). The Afghan Geological Survey kindly supplied us with some sheets of the 1:50.000 topographic map covering one part of central Badakhshan. We concentrated our activity principally in this area and gare up the idea of exploring the northern slopes of Hindu Kush which was situated outside the maps. Nevertheless we extended our investigation westwards, in Kataghan and in the districts of Pull-i-Khumri and Mazar-i-Sherif, in order to clear up some stratigraphic questions.

Most of the fossils described within this volume were collected to the west of the cristalline anticlinorium of Faydzabad, which runs from north to south linking the structures of Northern and Central Pamir with those of Badakhshan and Hindu Kush (Desio, 1965).

To the east of the anticlinorium few but very interesting fossils were collected, as in a small space specimens of different age were contained.

We are indebted to Eng. R. Varvelli, of the Engineering School of Turin and member of an Italian expedition to Hindu Kush, 1965, for the finding again one *fossiliferous locality in the Kalawch valley, discovered by us in 1961, and finding other fossiliferous beds belonging to the Lower Carboniferous (Corals) and to the Triassic (plants).*

The Corals were examined by A. von Schouppé of the Geological-Paleontological Institute of Münster University and the plants by P.D.W. Barnard of the Botany Department, University of Reading. The description are contained in this volume. I am grateful to the two scientists for their kind collaboration.

More abundant are the fossils collected to the west of Faydzabad anticlinorium where the sedimentary formations are very widespread. The fossils are prevailingly represented by Molluscs and Brachiopods belonging to the Cretaceous and Eocene.

Before dealing with this material I must mention a small collection of Jurassic fossils (Molluscs and Brachiopods) which we collected in the area of the Karkar mine studied by C. Rossi Ronchetti, director of the Paleontological Institute of the University of Milan. These fossils complete a previous study by the same author and Dr. N. Fantini Sestini on the fossil fauna of the Karkar formation (1961).

The Cretaceous and Eocene fossils were found in many localities but most of the them belong to the same formations. The fossils supplied us with the principal means for our stratigraphic correlations which started from the West Badakhshan and extended to the Kataghan and to the Pull-i-Khumri and Mazar-i-Sherif districts. I should like to mention here the particular significance of the collaboration between the micro and macropaleontologists in solving the difficult problems connected with those correlations. We are indebted to I. Premoli Silva of the Institute of Paleontology of the University of Milan for her study of the Cretaceous and Eocene Foraminifera and to A. Berizzi Quarto di Palo of the same Institute, who examined the rich collections of the Upper Cretaceous Molluscs and Brachiopods and of the Paleogene Pelecypods.

My thanks to all our able collaborators in the paleontological field whose work permitted us, the geologists, to have the best interpretation of the stratigraphy of Central Badakhshan and surrounding countries and which is contained in volume 2 of the III Part of the Scientific Reports of the Italian Expedition to the Karakorum (K^2) and Hindu Kush, led by Ardito Desio, to be published in the next months.

If the expedition to Central Badakhshan in 1961, organised and led by me, was successful in spite of the various hitches which reduced our activity, this is due to the assistance given on the part of the Italian and Afghan authorities, in addition and above all to the spirit of dedication and initiative which always animated my collaborators.

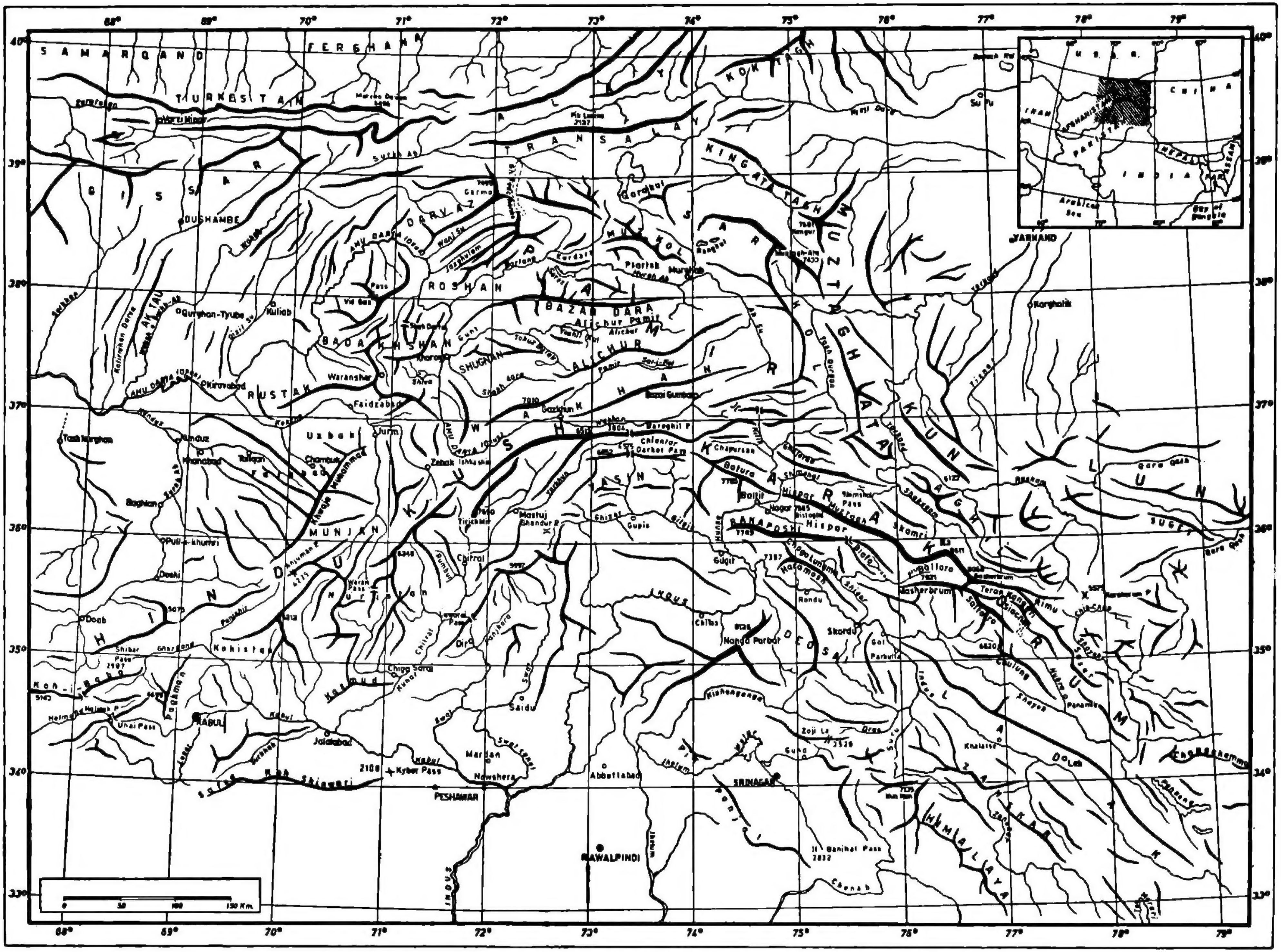
First of all I have to thank the Italian Research Council which financed the expedition, as without this help it would not have been possible to undertake it.

I must also thank the Afghanistan Embassy in Rome and the Foreign and Education Ministries of Afghanistan who went to a great deal of trouble in obtaining the necessary permits for us to go to Badakhshan. In particular I am also extremely grateful to our Foreing Ministry and above all our Ambassador at Kabul, His Excellency Folco Trabalza, whose intelligence, efficiency and assiduous assistance was superior the all expectations. At the same time I want to thank the Embassy staff, among whom I particularly remember Miss Anna Paris who did everything in her power during the difficult return phase to facilitate the transport of material back to Italy.

I am extremely grateful to Ministry of Mines Dr. S.A. Popol and to the Afghanistan Geological Survey, directed at that time by Dr. Abdul Samad Saleem in the service of the Ministry for Mines, who gave us ample and extremely useful assistance in supplying us with the topographic maps necessary for our work and putting at our disposal the existing relative geological documents.

My heartiest thanks must then go to my valiant collaborators who did their utmost in research work in the field, overcoming the difficulties which arose each day, and who had a great deal of understanding with the local inhabitants who gave us their most willing assistance. I must also thank the local authorities, from the Governor of Faydzabad to the soldiers who accompanied us on our excursions and who did their best to facilitate our work.

Ardito Desio



Orographic sketch-map of the Karakorum-Hindu Kush ranges and surrounding regions

CONTENTS

CARBONIFEROUS FOSSILS

LOWER CARBONIFEROUS CORALS FROM BADAKHSHAN (NORTH-EAST AFGHANISTAN)

by

ALEXANDER VON SCHOUPPÉ

Geologisch-Paläontologisches Institut der Universität Münster, Westfalien

The corals described and illustrated in the present paper are kindly put at my disposal by Prof. A. Desio (Milan), to whom I wish to express my sincerest thanks. Five genera of which three species (two of them sp. nov.) are identified. All of these specimens are collected from Kalawch Limestone, Kalawch River, Badakhshan by Eng. R. Varvelli during the Italian Expedition (1965) to Hindu Kush.

PALEONTOLOGICAL DESCRIPTIONS

RUGOSA

Fasciculophyllum Thomson, 1883

1883 *Fasciculophyllum* Thomson, p. 448.
1917 *Fasciculophyllum* — Gregory, pp. 223, 238.
1942 *Fasciculophyllum* — Hudson, p. 260.
1943 *Fasciculophyllum* — Hudson & Fox, p. 105.
1947 *Fasciculophyllum* — Jeffords, p. 18.
1952 *Fasciculophyllum* — Schindewolf, p. 177 (? partim).
1952 *Fasciculophyllum* — Lecompte in Piveteaux, p. 487.
1956 *Fasciculophyllum* — Hill in Moore, p. 260.
1962 *Fasciculophyllum* — Soškina & Kabakovič in Sokolov, p. 352 (1).
? 1962 *Fasciculiamplexus* — Easton, p. 31.
1962 *Fasciculophyllum* — Easton, p. 32.

(1) Russian names are transliterated in accordance with German Norms for Transliteration of Slavonic Cyrillic Characters (DIN 1460; 1962).

1966 *Fasciculophyllum* — Dobroljubova & Kabakovič, p. 21.
1967 *Fasciculophyllum* — Ivanovskij, p. 21.

(This list of synonyms does not lay claim to completeness).

Type species — By subsequent designation of Gregory, 1917, pp. 223, 238. *Fasciculophyllum dybowskii* Thomson, 1883, p. 449, pl. VI, figs. 23, 23a. Lower Carboniferous: Scotland.

Diagnosis — (With reference to Hudson, 1942). Zaphrentoidid solitary corals with predominantly relatively long major septa which are grouped in irregular to « palmate » (1) bundles. The latter reach or almost reach the axis. The cardinal fossula is only a little wider than the other interseptal space and usually extends near to the center and is divided in two by the cardinal septum. Counter septum long. As a result of the septa-bundling well-marked interseptal spaces are formed on both sides of the counter septum and the ventral side of each alarseptum. Minor septa are not present or as short spines developed in the ephebic stage. Generally the tabulae descend from the center to the periphery and near to the wall they ascend again. Dissepiments are absent.

Remarks — In the literature there are some disagreements in taxonomic extent of this zaphrentoid genus. Only an extensive revision of this genus-group can solve these disagreements (see *Zaphrentites*). At the present I submit this genus diagnosis based upon Hudson (1942) and Hudson & Fox (1943). No stereocolumella, as Schindewolf mistakenly states (1952, p. 176), can not be found in this genus. An axial structure can only be misled by the tabulae-elements cut at the center (Schouppé & Stacul, 1966, p. 142 et seq.).

Occurrence — Lower Carboniferous: Western and Eastern Europe, Asia.

Fasciculophyllum multiseptatum sp. n.

Pl. 1, fig. 1-7

Holotype — The specimen illustrated on pl. 1, fig. 1-7 (No. A65-A1503). Register number A1503.

Derivatio nominis — *Multiseptatum many-septate,* referred to the high number of septa for this genus.

---

(1) Hudson & Fox (1943, p. 105) distinguish the septa-bundling into a « pinnate » and a « palmate » one and give the following explanation: « Transverse sections of Zaphrentoid corals show that the septa are often grouped by those in one sector joining at their axial ends. Such confluent septa may be joined pinnately as in the *Zaphrentites delanouei* species-group, or palmately as in the *Fasciculophyllum omaliusi* species-group. In the former case there is a marked difference in the length of the septa in the one sector, the longest and shortest being respectively the first and last formed, both being the outer septa of the group. In latter case the septa are more equal in length but there is usually one long septum near the centre of the group: on either side of it, each septum leans against the next longer ».

Locus typicus — Kalawch River, Badakhshan (North-East Afghanistan).

Stratum typicum — Kalawch limestone.

Material — The description is based upon one specimen nearly complete except the primal part. 5 transverse sections presenting the neanic to ephebic stage and another representing the calyx region are cut therefrom.

Diagnosis — Representatives with septa amount to 42. Those in the cardinal quadrants are stouter.

Description — Externals. The small corallum as it is preserved is 15 mm long and is more or less conic in shape with a calyx diameter of 15 mm. The proximal part is not preserved and parts of the epitheca are weathered, so that at such place the septa appear naked.

Transverse sections. The transverse section illustrated on pl. 1, fig. 5 is presenting the ephebic stage out immediately below the calyx. This section is not whole but can be compared with the section somewhat underlain illustrated on pl. 1, fig. 4. Both the sections have a diameter of 15 mm. There are 42 major septa. In the cardinal quadrants they are dilated and mostly long, and in each quadrant they are irregularly to palmately bundled (s. foot-note 1, p. 6). These bundles reach the axis at times. The cardinal septum is long and lies in a prominent fossula. The counter septum is short and like the cardinal and the two alarsepta does not participate in the formation of the septa-bundling. Thereby the well-marked to some extent widened interseptal spaces on the both sides of the cardinal septum and on the ventral side of the alarsepta are formed. But they show no tabulae depression and therefore they should be called pseudo-fossula (Schouppé & Stacul, 1961; 1966, p. 134 et sep.). In the literature this term is applied to the interseptal spaces round the counter septum (Schindewolf, 1938, p. 189; Dobroljubova & Kabakovič, 1966, p. 23) while the interseptal spaces on the ventral side of the alarsepta are mistakenly described as true fossulae, namely alar-fossulae (Dobroljubova & Kabakovič, 1966, p. 23). As to the formation of fossula and pseudofossula see Schouppé & Stacul, 1966.

The minor septa rise not till the ephebic stage and remain short in the calyx too.

The cardinal fossula is well marked and is bounded by the neighbouring septa parallel or concave to the cardinal septum and they join together axially. The fossula does not extend to the center and is divided into two parts by the cardinal septum which reaches the center (Schindewolf, 1938, p. 442 speaks of two fossulae; see also Schouppé & Stacul, 1961, p. 24; 1966, p. 136).

The wall is composed of a preseptal and synseptal pallial secretion (= epitheca partim; Schouppé & Stacul, 1966, p. 68, 69, 83). The basal-elements appear only in form of tabulae, dissepiments are absent (Schouppé & Stacul, 1966, p. 91 et seq.).

2

The three transverse sections representing the neanic stage show essentially the same structure. At a diameter of 7 mm (pl. 1, fig. 1) there are 28, at a diameter of 9 mm (pl. 1, fig. 2) there are 32 and at a diameter of 11 mm (pl. 1, fig. 3) there are 38 major septa showing a more or less bilateral symmetry especially in the counter quadrants. The septa are likewisely long, reaching the axis and they are so dilated in the cardinal quadrants that they teach each other in the cardinal quadrants. Thereby the fossular loculus in this part of corallite is not recognizable. The cardinal septum can not be discriminated from the other major septa. The minor septa are not present at all. As seen at places (e.g. at a and b, pl. 1, fig. 1) the tabulae are in a special form of « skeletal-trough » developed (Schouppé & Stacul, 1966, p. 102 et seq.).

The uppermost section (pl. 1, fig. 6) cut through the calyx though incomplete, shows clearly the major septa are shortened. The cardinal septum is considerably shortened. Therefore the open fossular loculus is only suggestively recognizable. The minor septa are short but well developed. Some tabulae which ascend to the wall are cut at the periphery.

Remarks — On account of certain characteristics, e.g., the peculiar, irregular to palmate bundling of the major septa as well as the special forming of fossula (parallel to slightly concave to the cardinal septum, not extending over the center and divided by the cardinal septum into two) and the pseudofossular space round the counter septum — with reference to Hudson (1942) — I assign this species to the genus *Fasciculophyllum*. But the specimen differs from the up-to-date known species of this genus in having more septa, in the dilation of the major septa in the cardinal quadrants as well as in the peculiar arrangement of the last but one metasepta in each counter quadrant, and I believe these are sufficient to justify the erection of a new species.

Occurrence — Lower Carboniferous (Kalawch limestone): Kalawch River, Badakhshan (North-East Afghanistan).

Zaphrentites Hudson, 1941

1941 *Zaphrentites* Hudson, p. 309.
1943 *Zaphrentites* — Hudson & Fox, p. 120.
1944 *Zaphrentites* — Hudson, p. 146.
1952 *Zaphrentites* — Lecompte in Piveteau, p. 477.
1956 *Zaphrentites* — Hill in Moore, p. 267.
1958 *Amplexi-Zaphrentis* — Sutherland, p. 44 (? partim).
1962 *Zaphrentites* — Soškina & Kabakovič in Sokolov, p. 322.
1963 *Zaphrentites* — De Groot, p. 36, cum syn. (syn. partim ?).
1966 *Zaphrentites* — Dobroljubova & Kabakovič, p. 24 (cum syn).
1967 *Zaphrentites* — Ivanovskij, p. 41 (cum syn).

(The list of synonyms does not lay claim to completeness).

Type species — *Zaphrentites parallela* Carruthers, 1910, p. 533, pl. XXXII, fig. 4 a-d. Lower Carboniferous (Tournaisian), England.

Diagnosis — Solitary, trochoid corals with the prominent cardinal fossula variously disposed (on the concave, lateral or convex side of the curvature). For the greater part of the ontogeny this pronounced fossula generally remains especially in the axial region bounded by a septo-basal inner wall. The major septa are stout in the axial region most of them are rhopaloid and in the neanic stage pinnately arranged. In the mature stage the inner wall disappears at first at the cardinal quadrants and laterly also in the counter quadrants, and the septa project free and are radially arranged in the lumen. The minor septa, when present, short. Basal-elements are only as tabulae developed.

Remarks — There are considerable disagreements concerning to separate the genus *Zaphrentites* from *Zaphrentoides* and the other related genera in the literature. These disagreements can only be solved through an extensive revision. For a historical view concerning to the different opinions on these problems see, for istance, De Groot (1963).

Occurrence — Lower Carboniferous (Tournaisian): West and East Europe; Asia.

Zaphrentites sp.

Pl. 1, fig. 8-11

Material — 2 imperfect specimens completely embedded in the gray, fine-grained limestone. On the surface of the limestone the upper parts of the calyx are visible, 3 transverse sections cut therefrom (No. A65-V6/12, A65-V6/13).

Description — Externals. According to the sections cut from both specimens it can be concluded that they are trochoid in shape. The section which is visible on the surface of the limestone representing the uppermost part of the calyx attains a diameter of 11 mm (pl. 1, fig. 10, 11).

Transverse sections. The relatively best preserved section (pl. 1, fig. 8) is cut at middle part of the coral (late neanic stage) and does not yet reach the mature stage. It is only partly preserved as parts of the cardinal quadrants are not present. Even so the characteristic figure of *Zaphrentites* is recognizable. Among the 20 (estimated) major septa presenting in forming of the inner wall which is characteristic for this genus. This inner wall bounds the central space which is still occupied by the axial part of the fossula. This inner wall is formed with the axial ends of septa bending against the counter septum and beyond that it is reinforced by the tabulae that arch upward at this region. Therefore, with regard of its origin, it is to be called septo-basal one. The septa round about the cardinal septum, as far they can be observed in the breakage-zone, take no longer any part in the compact wall, but stretch their free axial ends of the septa to the lumen, thereby it results in this case an open fossula (see also De Groot, 1963, pl. 4, fig. 1 d). In this transverse section the cardinal septum can not be identified from the other major septa fragments in the cardinal quadrants. However, as far as it is recognizable, the septa in this region are attenuated.

The minor septa at the vicinity of the counter septum are as short spines recognizable. The basal-elements appear only in form of tabulae. Their sections become more abundant in the region of axial ends of septa, where, as shown in the longitudinal sections of other authors, they stretch upwards and thereby they participate in the forming of the inner wall.

As it can be clearly observed in the transverse sections cut at upper part of the corallite, the wall is composed of a preseptal and a synseptal, pallial secretion (epitheca in part; Schouppé & Stacul, 1966, pp. 68, 69). The latter is witnessed by the fact that the septa are inserted into the wall (in die Wand eingelassen).

The transverse section illustrated on pl. 1, fig. 9, is cut through the base of the calyx and only a part of the counter quadrants is preserved. All together there are seven major septa more or less radially arranged recognizable here. They are straight and no longer connected at axial part but terminate free in the lumen. The minor septa are here already as short, well developed spines inserted. Besides the uppermost tabula (the floor of the calyx), which ascends from the fossular depression to the counter quadrants and is intersected in the central region, more sections of the underlain tabulae are visible between the septa.

Remarks — As the illustrations of some other authors (e.g. Hudson, 1944, pl. I, fig. 1 a-c, *Zaphrentites crassus crassus*) show, in the typical case a more or less U-shaped closed fossula is developed especially at the late neanic stage which reaches to the axial region of the corallite (even going over the center). Its axial region is bounded by the above-mentioned septo-basal wall whose peripheral region is, however, bounded by the both septa neighbouring the cardinal septum, parallel or convex to the cardinal septum.

There are, however, some disagreements with the descriptions of other authors. Among others the illustrations of the representatives of this genus given by Hudson (1944, pl. I, fig. 2) and De Groot (1963, pl. 4, fig. 1 d) show that the axial ends of the major septa (except the cardinal septum) already in the neanic stage no longer always join to each other.

On the contrary, now and then one more septum (especially in the cardinal quadrants) extends its axial end free into the lumen. Thereby the above mentioned inner wall is interrupted in this region and it shows in this respect a feature changed. Furthermore the inner-wall-like formation in the axial part may have a more or less massive character. This arises when the central tabulae are cut obliquely and this means that the characteristic appearance of this structure depends on the position of the section cut.

The two fragmentary specimens, certainly conspecific, at my disposal agree closely to the transverse sections illustrated by Hudson (1941, pl. I, fig. 2 b, 2 d) showing *Zaphrentites tenuis* erected by him well as to *Zaphrentites paralleloides* described by De Groot from the Lower Carboniferous strata of Northern Spain (De Groot, 1963, pl. 4, fig. 1 d). *Zaphrentites tenuis* is distinguishable by having two long, thin minor septa on both sides of the counter septum but they are not present in the specimens studied. And *Zaphrentites paralleloides* is characterized by having, especially from the late neanic stage on, a longer counter septum. For this reason I do not assign the corals from Afghanistan described here to any of the both species, but just describe them and leave them unnamed, since they can not be disposed to any known species and owing to the poor preservation of the specimens it is not reasonable to erect a new species.

Occurrence — Lower Carboniferous (Kalawch limestone): Kalawch River, Badakhshan (North-East Afghanistan).

Caninophyllum Lewis, 1929

1929 *Caninophyllum* Lewis, p. 450.
1933 *Caninophyllum* — Yü, p. 57.
? 1933 *Caninophyllum* — Heritsch, p. 51.
1937 *Caninophyllum* — Dobroljubova, p. 73.
1939 *Caninophyllum* — Sanford, p. 407.
1940 *Caninophyllum* — Lang, Smith & Tomas, p. 31.
1941 *Caninophyllum* — Soškina, Dobroljubova & Porfir'ev, pp. 122, 251.
1944 *Caninophyllum* — Easton, p. 130.
1945 *Caninophyllum* — Moore & Jeffords, p. 144.
1952 *Caninophyllum* — Lecompte in Piveteau, p. 479.
1953 *Caninophyllum* — Easton & Gutschick, p. 17.
1953 *Caninophyllum* — Fomičev, p. 235.
1955 *Caninophyllum* — Fabre, p. 9.
1956 *Caninophyllum* — Hill in Moore, p. 292.
1958 *Caninophyllum* — Easton, p. 29.
1959 *Caninophyllum* — Zukalova, p. 328.
? 1960 *Caninophyllum* — Langenheim & Tischler, p. 125.
1961a *Gshelia* — Schouppé, p. 364 (partim).
1961a *Caninophyllum* — Schouppé, p. 314.
1962 *Caninophyllum* — Dobroljubova in Sokolov, p. 314.
1963 *Caninophyllum* — Kato, pp. 600, 622.

1964 *Caninophyllum* — Fedorowski, p. 140.
1964 *Caninophyllum* — Easton & Melendres, p. 414.
1964 *Caninophyllum* — Carlson, p. 663.
1965 *Caninophyllum* — Fedorowski, p. 13.
1966 *Caninophyllum* — Dobroljubova & Kabakovič, p. 75.
1966 *Caninophyllum* — Bykova, p. 38.
? 1966 *Caninophyllum* — Flügel, H. p. 110.
1967 *Caninophyllum* — Ivanovskij, pp. 27, 53, 57.

Type species (Holotype) — *Cyathophyllum archiaci* Edwards & Haime, 1852, 183, pl. 34, fig. 7. Lower Carboniferous (Viséan), North Wales.

Diagnosis — Solitary, certatoid corals with more or less long major septa till (late) ephebic stage. They never join together in the axial region and are dilated up to the calyx in the cardinal quadrants and in the counter quadrants so are they occasionally at the youth stage too. The length of the minor septa are variable. Septa lamellar. Cardinal fossula open, cardinal septum more or less shortened, counter septum long.

Remarks — See also Dobroljubova & Kabakovič (1966, p. 75). Hereto is to be mentioned, owing to the remarkable resemblance of the *Caninophyllum kokscharowi* group in the mature stage I considered, however, with reservation, this genus as synonym of *Gshelia* in 1961 a. Dobroljubova (1940, p. 73) states the same that it is quite possible among the numerous specimens described as *Caninophyllum kokscharowi* may be representatives of the Genus *Gshelia*. On account of the disagreements presented it is not possible (justified) to undertake a complete synonymization.

Occurrences — Upper Carboniferous: Ural, ? Carnic Alps; Carboniferous: Africa; Lower Carboniferous: Europe, Asia and North America.

Caninophyllum tomiense (Tolmačev, 1931)

Pl. 1, fig. 12-13; Pl. 2, fig. 1-7

1931 *Caninia patula* Tolmačev, p. 329.
1931 *Caninia tomiensis* Tolmačev, p. 330.
1931 *Caninia derjawini* Tolmačev, p. 333.
1931 *Caninia opposita* Tolmačev, p. 336.
1931 *Caninia patula* var. *tomiensis* — Fomičev, p. 24.
1960 *Caninia patula* var. *tomiensis* — Soškina, p. 296.
1962 *Caninia patula* var. *tomiensis* — Dobroljubova & Kabakovič, p. 121.
1962 *Caninophyllum patulum* var. *tomiensis* — Dobroljubova in Sokolov, p. 314.
1966 *Caninophyllum tomiense* — Dobroljubova & Kabakovič, p. 77.

Rermarks — Concerning to the list of synonyms it is added to mention that referred to Lewis the name *Caninophyllum patulum* must exist already before Tolmačev, since according to Lewis the specimens described as *Canina patula* Mich. (1846) by Salée are only in part identical to *Caninophyllum archiaci*. The others are, according to Lewis, conspecific with *Caninophyllum patulum*. Should the last species be identical to *Caninophyllum patulum* (Tolmačev 1931), then the species name *patulum* has the priority over *tomiense*. The Russian authors do not make any comment on it and it is impossible for me to solve this problem here.

Lectotype — (By subsequent designation of Dobroljubova & Kabakovič, 1966) *Caninia patula* Tolmačev, 1931, p. 329, pl. 19, fig. 16-18. Lower Carboniferous (Tournaisian): Kuzneck Basin, Specimen No. 255 CGM.

Diagnosis — Middle to large representatives of *Caninophyllum* with a mean maximum diameter 30-40 mm, in extreme case it may attain to 55 mm. Major septa are relatively long, however, only rarely reaching the axis, in the cardinal quadrants they are somewhat shorter and are dilated till to the calyx. The slightly longer major septa of the counter quadrants are only occasionally slightly dilated in the neanic stage. The minor septa are differently developed. Commonly they are relatively short but occasionally they may be of various length. The basal-elements form a more or less central tabulae-zone and peripheral dissepiment-zone. The latter is developed only from the ephebic stage on and chiefly in the counter quadrants. The tabulae are often incomplete and blister-like arched peripherally and more or less horizontal to slightly sagging in the axial region. Where the septa are dilated, a special form of the tabulae, « skeletal-trough » (Skelettwannen) are formed.

Material — 2 imperfect specimens are studied. 12 sections (4 longitudinal and 8 transverse) partly only as fragment preserved are cut therefrom.

Description — Externals. The corals are ceratoid in shape, 40-50 mm long with a calyx 29 mm in diameter. Where the wall is weathered or abraded the longitudinal costae stand out representing the peripheral ends of the septa.

Transverse sections. All the sections are imperfect, most of them lack the peripheral parts. In the section cut through the calyx the counter quadrants are almostly abraded. Moreover the recristallization and metamorphosis, especially at the periphery of the sections, obliterate the skeleton structures. The section cut at the base of the calyx representing the mature stage (pl. 2, fig. 1) shows 50 unequally long major septa at a diameter of 25 mm. Owing to the previous shortening of septa a broad space in the center is left free of septa. In the cardinal quadrants they attain a length half as long as the radius in average and show a more or less pinnate arrangement. Except the axial ends they are dilated (the peripheral portions are not always preserved). This dilation is of basal origin and is caused through the lateral portions of the interseptal « skeletal-trough ». (s. Schouppé & Stacul, 1966, p. 102 et seq.) (comp. Basalelemente). The dilated and slightly shortened cardinal septum is situated in a well-marked, open fossula which becomes broader towards the center. The major septa of the counter quadrants have a length longer than 2/3 the radius and are thread-like attenuated, more or less radial arranged. The counter septum with regard to its length, is variably developed. In the section studied it is not distinguishable from the other major septa, but in some specimens of this species it is distinguished through its length. Dobroljubova & Kabakovič (1966, p. 80) have already pointed out this irregularity. In this thin section the minor septa appear only in the counter quadrants and they attain, the length increasing in the direction from the alarsepta to counter septum, to 1/2 the length of the major septa. Such development of the minor septa in this specimen is to be regarded as an extreme case for this species. But Dobroljubova & Kabakovič (1966, p. 80) also point out the possibility of different development of the minor septa.

The wall is composed of different morphogenetic elements. The outmost portion of the counter quadrants, where the septa are thread-like fine, is male of a preseptal, pallial secretion (= epitheca partim; s. Schouppé & Stacul, 1966, pp. 68, 77, 83). This secretion is here and there (distinctly visible in the vicinity of alarsepta) reinforced by a synseptal secretion. Thereby the septa appear as they are inserted in the wall (s. Schouppé & Stacul, 1966, p. 83 et seq.). In the cardinal quadrants where the septa are dilated till the wall which may be fortified postseptally through the peripheral portions of the interseptal « skeletal-trough » (s. Schouppé & Stacul, 1966, p. 68, 117). The open fossula extending to the center is distinctly recognizable. The basal-elements are developed both in form of dissepiments (sensu Schouppé & Stacul, 1966, p. 91 et seq.) and tabulae which appear as a special form, the interseptal « skeletal-trough » (s. Schouppé & Stacul, 1966, p. 102 et seq.) (s. below). In this thin section a dissepiment-zone appears only at the periphery of the counter quadrants and attains its maximum breadth (about 1/3 the radius) on both sides of the counter septum. It is here impossible with the transverse section to distinguish the dissepimentarium from the tabularium, because, as the longitudinal section shows, the peripheral parts of the tabularium are composed of arched vesicular elements.

In the cardinal quadrants of this transverse section there is no peripheral dissepiment can be ascertained, because the major septa, as far as it is recognizable on the preserved periphery, are dilated continously to the wall. In this case the tabularium reaches the wall and the peripheral part and is characterized by the formation of the interseptal « skeletal-trough » — a special development form of the tabularium — whose lateral portions play an essential role in the dilation of the septa (s. Schouppé & Stacul, 1966, p. 102 et seq.) (s. above). The typical appearence and the perfect form are not represented, respectively not clearly represented, in this section studied. This is on the one side due to fact that the peripheral parts of the corallum are missed, in turn the peripheral parts of the « skeletal-trough » are not preserved. On the other side it is owing to the dipping of the tabulae to the center, so that no « bottom of trough » the typical between the major septa are intersected and so that the typical appearance of a interseptal « skeletal-trough » is not displayed in the transverse section. Only the lateral portions of the « skeletal-trough » are remarkably developed as they cause the dilation of the septa. On some spots of this section, at least, parts of the peripheral portions of the « skeletal-trough » are recognizable. Whereas the typical structure of the « skeletal-trough » is on some spots in other sections (e.g. a.t. a pl. 2, fig. 5) distinctly recognizable. Illustrations of some authors (e.g. Dobroljubova & Kabakovič, 1966, pl. XI) occasionally show a dissepiment zone, relatively thin though be, between the wall and the dilation of septa which, in this case, is shiftened inward. Where this type occurs, the tabularium hence does not reach but leave a certain interval from the wall. From here on the tabularium arises in form of the « skeletal-trough » which dilate the septa and which do not issue, in this case, from the wall but from the axial part of dissepiments. With the entrance of this formation a dilation-zone is distinctly marked. This, principally only in the cardinal quadrants, does not arise till a distance from the wall, and it is to be called a not persistent, basal innerwall s.l. (Innenwand s.l.). Dobroljubova & Kabakovič (1966, p. 81) also mention such kind of formation in the cardinal quadrants. The presepiments (s. Schouppé & Stacul, 1966, p. 128 et seq.) are at least not distinctly observed in this and the other sections studied, whereas the illustration of the Russian authors (Dobroljubova & Kabakovič, 1966, pl. XI, fig. 1m) shows the occasional and faint appearance of this formation at the periphery cut at an upper part of the corallum.

Sections cut in lower portion of the corallum (pl. 1, fig. 12, 13) show 33 and 41 relatively long major septa at the respective diameter of 14 and 18 mm. They are likewisely remarkably dilated in the cardinal quadrants, but in the counter quadrants also they are stouter than in the mature stage. The cardinal septum is relatively long and lies in the open fossula. The minor septa here too are recognizable only in the counter quadrants and are relatively short. The basal-elements are only as tabulae present. Where the periphery in the cardinal quadrants is to some extent preserved, the tabulae appear isolatedly in form of interseptal « skeletal-trough ». A pronounced dissepiment-zone in the counter quadrants is not yet present.

The sections cut at the uppermost part of the corallum (pl. 2, fig. 2, 3, 6) are incomplete, since the counter quadrants are much missed. The major septa already shortened still show distinctly their characteristic dilation. The cardinal septum that is likewisely dilated lies in a wide open fossula. The minor septa are not present in the section illustrated on pl. 2, fig. 3 as well as in the cardinal quadrants of the sections cut at the lower parts of the same specimen. In the section illustrated on pl. 2, fig. 6 cut from another specimen, on the contrary, the minor septa appear, irregular though be, in the cardinal quadrants, the same is shown, for instance, in the specimen illustrated by Lewis (1929, p. XI, fig. 1 b). The basal-elements are only as tabulae for the most part in form of interseptal « skeletal-trough » present in the cardinal quadrants (pl. 2, fig. 6). At the preserved rest of the region of the alarsepta a thin peripheral dissepiment-zone is observable (pl. 2, fig. 3).

Longitudinal section. The section situating at the base of the calyx is cut through the interseptal space adjoining the cardinal and the counter septum and parallel to them, passing through the fossula at the right segment (pl. 2, fig. 4). It shows clearly that the uppermost tabula (i.e. floor of the calyx) descends steeply at the periphery, then becomes flat — faintly undulating — toward the center and at the center slightly sagging. Whereas the left segment of the section representing the region of the counter septum there is a dissepiment-zone at the periphery composed of three series of relatively small dissepiments. Following on this toward the center, a not clearly defined tabularium is present, since its peripheral part is composed of blister-like arched tabulae.

Remarks — Our specimens agree very closely with the description of *Caninophyllum tomiense* (Tolmačev, 1931) given by Dobroljubova & Kabakovič (1966, p. 77, pl. X-XI). They differ from the Russian representatives only in having remarkable long minor septa and a somewhat longer cardinal septum. Since the Russian authors state the possibility of different development of the minor septa in this species, I consider it is desirable (justified) to regard them as conspecific.

Occurrence — Lower Carboniferous (Tournaisian): USSR (Kuzneck Basin, Ural, Russian Platform); Kalawch River, Badakhshan (North-East Afghanistan).

Amygdalophyllum Dun & Benson, 1920

1920 *Amygdalophyllum* Dun & Bensons, p. 339.
1923 *Amygdalophyllum* — Benson & Smith, p. 161.
1934 *Amygdalophyllum* — Hill, p. 67.
1935 *Amygdalophyllum* — Chi, p. 23.
? 1937 *Amygdalophyllum* — Dobroljubova, . 79.
1940 *Amygdalophyllum* — Lang, Smith & Thomas, p. 17.
1951 *Amygdalophyllum* — Minato, p. 3.
1955 *Amygdalophyllum* — Minato, p. 145.
1956 *Amygdalophyllum* — Hill in Moore, p. 290 (? partim).
1958 *Amygdalophyllum* — Sutherland, p. 76.
1960 *Amygdalophyllum* — Langenheim & Tischler, p. 122.
1961 *Amygdalophyllum* — Yamagiwa, p. 152.

1961 *Amygdalophyllum* — Yamagiwa, p. 103.
1962 *Amygdalophyllum* — Dobroljubova in Sokolov, p. 332.
1967 *Amygdalophyllum* — Ivanovskij, p. 69.

(This list of synonyms does lay claim to completeness).

Type species — *Amygdalophyllum etheridhei* Dun & Benson, 1920, p. 339, pl. XVIII, fig. 2-6 (non fig. 1). Lower Carboniferous (Visean): Australia (New South Wales).

Diagnosis — (With reference to Benson & Smith, 1923, p. 161 and Hill, 1934, p. 67). Solitary, conical to cornute corals with numerous long major septa, whose axial portions form a remarkable large solide elliptical septal columella, long cardinal septum, long minor septa and a (? wide) zone of fine dissepiments and incomplete domed tabulae.

Remarks — As to the morphogenetic characterization as well as to the taxonomic extent of this genus it prevails diverse opinions among the authors. For example, Benson & Smith (1923, p. 162) state in their description of the type species: « the cardinal fossula (although not conspicuous) can be distinctly recognized (in pl. VIII, fig. 1-3, and pl. IX, fig. 2) ».

But the illustrations of the transverse sections cited by them do not demonstrate any formation of a fossula, because even a somewhat well-marked interseptal space is here not recognized (the longitudinal sections are missing which are indispensable to ascertain a fossula beyond a doubt; see Schouppé & Stacul, 1959, p. 30; 1966, p. 138).

According to Hill (1956, p. 291) *Amygdalophyllum* as well as the genera she considers as synonyms of *Amygdalophyllum* — *Echigophyllum* Yabe & Hayasaka, 1824; ? *Carinthiaphyllum* Heritsch, 1936; *Ekvasophyllum* Parks, 1951 — possesses a prominent fossula, though no such feature can be found in her illustrations of *Amygdalophyllum* (1956, fig. 198 a-b). Nevertheless Sutherland (1958) and some authors consider *Ekvasophyllum* as an independent genus. As the most important criterion to maintain the genus *Ekvasophyllum* Parks sensu Sutherland, as the author asserts, that *Ekvasophyllum* possesses a prominent fossula while *Amygdalophyllum* has none. As matter of fact the illustrations of Parks and especially the longitudinal sections supplemented by Sutherland show clearly a prominent fossula. Langenheim & Tischler (1960, p. 122) also regard *Ekvasophyllum* as an independent genus and give as characteristic the presence of a prominent fossula, which, according to them, is absent in *Amygdalophyllum* as well as in *Carinthiaphyllum*.

I agree in this opinion that *Ekvasophyllum* is indeed nearly related with *Amygdalophyllum* but an independent genus, since *Ekvasophyllum* has a prominent fossula with a perpetually short cardinal septum. Concerning the basal-elements up-to-date it prevails in the literature that *Amygdalophyllum* as well as *Ekvasophyllum* is characterized by having a dissepiment-zone (Schouppé & Stacul, 1966, p. 91 et seq.). But as matter of fact at least some longitudinal sections illustrated by Sutherland (1958, pl. XX, fig. 21; pl. XXI, fig. 1 n) show that the basal-elements of *Ekvasophyllum* are composed principally to exclusively of tabulae and dissepiments rise at the utmost only as a thin zone at the peripheral part. On the contrary *Amygdalophyllum*, as far as they are known, have a wide fine zone of dissepiments.

Occurrence — Lower Carboniferous: E. Australia; Europe; Asia.

Amygdalophyllum ? kalawchense sp. n.

Pl. 3, fig. 1-5

Holotype — The specimen illustrated on pl. 3, fig. 1-5 (No. A65-A1504). Register number A1504.

Derivatio nominis — After the Kalawch Limestone, wherein the present specimen found.

Locus typicus — Kalawch River, Badakhshan (North-East Afghanistan).

Stratum typicum — Kalawch Limestone.

Material — Two incomplete specimens, one of them only fragmentary and poorly preserved, five transverse sections representing the neanic stage to ephebic stage and an additional section situated in a higher position (the calyx) cut therefrom. It is impossible to prepare a longitudinal section.

Diagnosis — *Amygdalophyllum* with a spindle-shaped septal columella which is connected with the long cardinal and the counter septum till the mature stage, and long major septa mostly reaching to the columella. Minor septa relatively long, about one half the radius.

Description — Externals. The specimens are embedded in dense, fine-grained limestone, as far as they can be observed, they are slightly curved conical, solitary corals.

Transverse sections. The sections cut in later neanic stage (pl. 3, fig. 1) show at a diameter of 13 mm about 40 and in the ephebic stage (pl. 3, figs. 2, 3) 44 long major septa, mostly reaching to the columella. Some of these septa are broken in a certain area of the thin sections. They are shortened only in the vicinity of the cardinal septum and are no longer, or at least no longer directly connected with the columella. Thereby the septa in the vicinity of the cardinal septum show a pinnate arrangement, while the others display a more or less radial symmetry. Among the protosepta only the cardinal and the counter septum are striking by their length. They connect themselves with the central axis and mark a traverse plan. The minor septa are long, attain in the cardinal quadrants nearly, in the counter quadrants even more than half length of the radius. All septa rare slightly dilated at the periphery. In the axial region, a massive, spindle-shaped, persistent axial structure is to be found in the plan of cardinal and counter septum. This structure remains in connection with the cardinal and the counter septum as well as the most of the major septa till the mature stage. It is composed essentially of the axial prolongation of the counter septum, as well as the axial portion of the other septa. Basal-elements as tabulae or tabellae participate only subordinately its constitution. In the calyx the axial structure becomes independent. It is clearly a septal columella in sense of Schouppé & Stacul (1966, p. 144).

The wall is composed of different morphogenetic elements. The most external portion is made of more or less thin, only on few spots preserved, preseptal pallial-secretion (= epitheca in part; Schouppé & Stacul, 1966, p. 68, 77, 83). From the portion where the septa are inserted into the wall (in die Wand eingelassen), there is a synseptal pallial-secretion (epitheca in part; Schouppé & Stacul, 1966, p. 83 et seq.). Here and there the dilation of the septa toward the periphery makes the septa laterally, uninterruptedly conjoined with the neighbouring ones and thereby a supplementary septal wall (= pseudotheca in part; Schouppé & Stacul, 1966, p. 77) reinforces the pallial wall already present.

The pinnate arrangement of the last metasepta gives rise to the faintly defined interseptal space in the vicinity of the cardinal septum which extends to the axis and divides the interseptal space into two parts. Whether the interseptal space is realy a true fossular depression or not (see also remarks), can not be judged merely by transverse sections (see Schouppé & Stacul, 1959, p. 21 et seq.; 1966, p. 134 et seq.).

Concerning the basal-elements (Schouppé & Stacul, 1966, p. 91), though no longitudinal section can be made, the situation as well as the distribution of the intersected elements in the interseptal space in transverse sections show that there is no wide and fine peripheral dissepiment-zone at all present. The intersected basal-elements are in no case confined to the periphery, but over all the transverse section distributed and beyond that they are more abundant toward the axis. This indicates that it is not a peripheral dissepiment-zone but the more or less arched tabulae, which arch especially in the axial region upwards against the columella, but take no essential part in its constitution. Only in the outmost part it is possible that the basal-elements rise in form of dissepiments.

The uppermost transverse section (pl. 3, fig. 4) we have is cut through the calyx and it shows at a diameter of 15 mm the already shortened septa, however, they are broken, and in the axial region the free columella. The columella is essentially composed of a median-plate and supplementary of axial-plates (Schouppé & Stacul, 1966, p. 144).

Remarks — It is not easy even identify these specimens generically. Though the formation of the columella conforms that of, for example, the representatives of the genus *Ekvasophyllum* illustrated by Sutherland (1958, pl. XX), thereby at first sight it makes an impression on a certain identification; these specimens differ from them above all in having the long cardinal septum. The cardinal septum lies in a faintly defined interseptal space which is divided by it. The fossular character of this interseptal space is by no means doubtlessly ascertained (no longitudinal section can be made). Agreements with the genus *Amygdalophyllum* are demonstrated by the relatively long minor septa and the long cardinal septum.

On the other hand, as already mentioned, *Amygdalophyllum* is supposed to have a wide fine dissepiment-zone which is, indeed, not developed in these specimens. As far as it can be observed in the transverse sections here it must be a wide expanded tabularium with tabulae inclined upward towards the axis. A dissepiment-zone can be formed merely in the outmost part.

Since these are no unessential disagreements with the known representatives of *Amygdalophyllum*, I assign these specimens described here, to this genus with some doubt. It is quite possible that they are of a proper genus (with solid columella, long cardinal septum, thin dissepiment-zone and ? fossula), but the establishment must be based upon better materials.

Occurrence — Lower Carboniferous (Kalawch Limestone): Kalawch River, Badakhshan (North-East Afghanistan).

TABULATA

Michelinia De Koninck, 1842

Type species — (By subsequent designation of Edwards & Haime, 1850, p. 60) *Calamopora tenuiseptata* Phillips, 1836, p. 201, pl. II, fig. 30 from the Lower Carboniferous of Bolland and the Mendips.

Michelinia ? sp.

Pl. 3, fig. 6-8

Material — Among the collection of the corals there is a fragment of a colonial corallum. 1 transverse and 2 longitudinal sections cut therefrom. (No. A65-V6/16).

Description — The transverse section (pl. 3, fig. 6) shows a fragment of a corallum with three corallites of different shape. The largest one with a diameter of 6 mm has a circular outline. The smallest one, apparently a juvenile corallite, is somewhat triangular in shape. The lamellar wall is thick (about 0.4 mm). The irregular, incomplete tabulae are intersected in the lumen. Pores and spines are not observed in this thin section.

The longitudinal section (pl. 3, fig. 7) merely shows a part of the three corallites and two of them are incomplete. The corallites attain a maximum diameter of 8 mm. The thick wall shows a clear dark medium line. The tabulae, which are partly ruptured, are partially incomplete, horizontal to concave. Spines and pores are not observed.

In the second fragmentary longitudinal section (pl. 3, fig. 8) a pore in the wall is distinctly recognizable. No spines are intersected.

Remarks — Because of the fragmentary preservation it is impossible to identify them more exactly.

All the features described above, especially those of the longitudinal section, suggest the specimen studied may be of the genus *Michelinia*.

Occurrence — Lower Carboniferous (Kalawch Limestone): Kalawch River, Badakhshan (North-East Afghanistan).

References

BASSLER R. S., 1950 — *Faunal Lists and Descriptions of Palaeozoic Corals.* Mem. Geol. Soc. Amer., vol. 44, pp. I-IX, 1-315, pl. 1-20, Washington.

BENSON W. N., SMITH S., 1923 — *On some Rugose Corals from the Burindi Series (Lower Carboniferous) of New South Wales; together with a Short Account of the Upper Palaeozoic Rocks of the Area in which they were collected.* Quart. J. Geol. Soc., vol. 70, pp. 156-171, pl. VII-IX, London.

BYKOVA M. S., 1966 — *Nižnekamennougol'nye Korally vostočnogo Kazachstana.* AN Kzachstoj SSR, pp. 1-214, pl. I-XXVI, 5 fig., tab. 1, Alma-Ata.

CARLSON K. J., 1964 — *Corals of the Gilmore City Limestone (Mississippian) of Iowa.* J. Paleont., vol. 38, n. 4, pp. 662-666, 2 pl., Tulsa, Oklahoma.

CARRUTHERS R. G., 1908 — *A Revision of some Carboniferous Corals.* Geol. Mag., N.S., (5), vol. 5, pp. 20-31, 63-74, 158-171, pl. 4-6, 6 fig., London.

CARRUTHERS R. G., 1910 — *On the Evolution of Zaphrentis delanouei in Lower Carboniferous Times.* Quart. J. Geol. Soc., vol. 64, pp. 523-538, pl. 36-37, London.

CHI Y. S., 1935 — *Additional Fossil Corals from the Weiningian Limestone of Hunan, Yunnan and Kwangsi Provinces, in S.W. China.* Palaeont. Sinica, **B**, vol. 12, n. 6, pp. 1-38, pl. 1-3, Peking.

DE GROOT G. E., 1963 — *Rugose Corals from the Carboniferous of Northern Palencia (Spain).* Leids Geol. Meded., vol. 29, pp. 1-123, pl. 1-26, fig. 1-39, Leiden.

DOBROLJUBOVA T. A., 1937 — *Odinočnye Korally Mjačkovskogo i Podol'skogo gorizontov srednego Karbona Podmoskovnogo Bassejna.* Tr. Paleozool. Inst., vol. 6, n. 3, pp. 1-92, pl. I-XXIII, Moskva - Leningrad.

DOBROLJUBOVA T. A., 1940 — *Korally Rugosa verchnego Karbona Podmoskovnogo Bassejna.* Tr. Paleont. Inst., vol. 9, n. 3, pp. 1-88, pl. I-XXV, Moskva - Moskva.

DOBROLJUBOVA T. A., 1962 — *Podotrjad Caniniina and Podrotrjad Acrophyllina* - In So-

KOLOV B. S.: *Gubki, Archeociaty, Kišečnopolostnye, Cervi.* Osnovy Paleontologii, vol. 2, pp. 314-317 and 327-332, Moskva.

DOBROLJUBOVA T. A., KABAKOVIČ N. V., 1962 — *Tip Coelenterata. Kišečnopolostnye.* V Swodke: *Biostratigrafija Paleozoja Sajano-Altajskoj gornoj oblasti,* III. *Verchnij Paleozoj. Kamennougol'naja sistema.* Tr. SNIIGGiMC, vol. 21, pp. 115-1240, Novosibirsk.

DOBROLJUBOVA T. A., KABAKOVIČ N. V., 1966 — *Cetyrechlučevye Korally niznego Karbona Kuzneckoj kotloviny.* V: *Korally niznego Karbona Kuzneckoj Kotloviny, AN SSSR.* Tr. Paleont. Inst., vol. 111, pp. 1-276, pl. I-XLV, fig. 1-16, 10 tab., Moskva.

DUN W. S., BENSON W. N., 1920 — Section B: *Palaeontology.* In BENSON W. N., DUN W. S., BROWN W. R.: *The Geology, Paleontology and Petrography of the Currabubula District, with notes adjacent regions.* Proc. Linn. Soc. New South Wales, vol. 45, pp. 337-374, pl. XVIII-XXIV.

EASTON W. H., 1944 — *Corals from the Chouteau and Related Formations of the Mississippi Valley Region.* Illinois Geol. Surv. Rept. Invest., vol. 97, pp. 1-62, (62-93), pl. 1-17, 1 fig., 1 tab., Urbana, Illinois.

EASTON W. H., 1958 — *Mississippian Corals from Northwestern Sonora, Mexico.* Smithsonian Misc. Coll., vol. 119, n. 3, pp. 1-40, pl. 1-2, fig. 1-3, Washington.

EASTON W. H., 1962 — *Carboniferous Formations and Faunas of Central Montana.* U.S. Geol. Surv. Prof. Pap., vol. 348, pp. 1-126, pl. 3-13, Washington.

EASTON W. H., GUTSCHICK R. C., 1953 — *Corals from the Redwall Limestone (Mississippipian) of Arizona.* Bull. Southern Calif. Acad. Sci., vol. 52, pp. 1-27, 3 pl., 2 fig.

EASTON W. H., MELENDRES M. M., 1964 — *A Paleozoic Coral from Mindoro.* J. Paleont., vol. 38, n. 2, pp. 412-414, 1 fig., Tulsa, Oklahoma.

EDWARDS H. M., HAIME J., 1851 — *Monographie des Polypiers fossiles des Terrains paléozoiques.* Arch. Mus. Hist. Nat., vol. 5, pp. 1-502, pl. I-XX, Paris.

EDWARDS H. M., HAIME J., 1852 — *A Monograph of the British Fossil Corals.* Part III. *Corals from the Permian Formation and the Mountain Limestone.* Monogr. Palaeont. Soc. London, pp. 147-210, pl. XXXI-XIVI, London.

FABRE J., 1955 — *Deux polypiers viséen supérieur de Tindouf (Sahara N.W.): Caninophyllum archiaci (M. Ed. & H.) var. densa nov. var., et Carcinophyllum coronatum nov. sp.* Ann. Soc. Géol. Nord, vol. 75, pp. 8-14, pl. 1-3, Lille.

FEDOROWSKI J., 1964 — *On Late Palaeozoic Rugosa from Hornsund, Westspitsbergen.* Stud. Geol. Polon., vol. 11, n. 3, pp. 139-146, 1 tab., Warszawa.

FEDOROWSKI J., 1965 — *Lower Permian Tetracoralla of Hornsund, Westspitsbergen.* Stud. Geol. Polon., vol. 17, n. 4, pp. 1-173, pl. I-XV, 61 fig., 8 tab., Warszawa.

FLÜGEL H., 1966 — *Paläozoische Korallen aus der Tibetischen Zone von Dolpo (Nepal).* Jb. Geol. Bundesanst., Sonderband 12, pp. 101-120, pl. 1-4, Wien.

FOMIČEV V. D., 1931 — *Novye dannye o Nižnekamennougol'nych Korallach Kuzneckogo Bassejna.* Tr. Gl. Geol. Razved. Upr., vol. 49, pp. 1-80.

FOMIČEV V. D., 1953 — *Korally Rugosa i stratigrafija Srende- i Verchnekamennougol'nych i Permskich otloženij Doneckogo Bassejna.* Tr. VSEGEI, pp. 1-622, pl. I-XLIV, Moskva.

GREGORY J. W., 1917 — *Thomson's Genera of Scottish Carboniferous Corals.* Trans. Geol. Soc. Glasgow, vol. 16, n. 2, pp. 220-243, Glasgow.

HERITSCH F., 1933 — *Rugose Korallen aus dem Trogkofelkalk der Karawanken und der Karnischen Alpen.* Prirodoslovne Razprave, vol. 2, pp. 42-55, pl. 5-6, Ljubljana.

HILL D., 1934 — *The Lower Carboniferous Corals of Australia.* Proc. Roy. oc. Queensland, vol. 45, n. 12, pp. 63-115, pl. 7-11, fig. 1-6, Brisbane.

HILL D., 1938-1941 — *A Monograph on the Carboniferous Rugose Corals of Scotland.* Monogr. Palaeont. Soc. London, 213 pp., 11 pl., London.

HILL D., 1956 — *Rugosa, Heterocorallia.* In MOORE R. C.: *Treatise on Invertebrate Paleontology.* Part. F. *Coelenterata.* Geol. Soc. Amer. and Univ. Kansas Press, pp. 233-327, fig. 165-221, New York.

HUDSON R. G. S., 1941 — *On the Carboniferous Corals: Zaphrentis carruthersi sp. nov. from the Mirk Fell Beds and its relation to the Zaphrentis delanouei species-group.* Proc. Yorkshire Geol. Soc., vol. 24, pp. 290-311, pl. 21-22, 1 fig., Wakefield.

HUDSON R. G. S., 1942 — *Fasciculophyllum Thomson and Other Genera of the «Zaphrentis» omaliusi group of Carboniferous Corals.* Geol. Mag., vol. 79, pp. 257-263, 2 fig., Hertford.

HUDSON R. G. S., 1944 — *On the Lower Carboniferous Corals: Zaphrentites crassus and Z. tenuis sp. nov.* Ann. Mag. Nat. Hist., vol. 11, n. 11, pp. 145-154, pl. 1, 1 fig., London.

HUDSON R. G. S., FOX T., 1943 — *An Upper Visean Zaphrentoid Fauna from the Yoredale Beds of North-West Yorkshire.* Proc. Yorkshire Geol. Soc., vol. 25, n. 2, pp. 101-126, pl. 9-12, Wakefield.

IVANOVSKIJ A. B., 1967 — *Etjudy o rannekamennougol'nych Rugozach.* Izd. «Nauka», pp. 1-92, pl. I-XXII, 22 fig., Moskva.

JEFFORDS R. M., 1947 — *Pennsylvanian Lophophyllidid Corals.* Univ. Kansas Paleont. Contr., n. 1, *Coelenterata,* Art. 1, pp. 1-84, pl. 1-28, fig. 1-9, Topeka, Kansas.

KATO M., 1963 — *Fine Skeletal Structures in Rugosa.* J. Fac. Sci. Hokkaido Univ., ser. 4, Geol. Min., vol. 11, n. 2, pp. 571-630, pl. I-III, 19 fig., Sapporo.

LANG W. D., SMITH S., THOMAS H. D., 1940 — *Index of Palaeozoic Coral Genera.* Brit. Mus. (Nat. Hist.), pp. VII + 1-231, London.

LANGENHEIM R. L., TISCHLER H., 1960 — *Mississippian and Devonian Paleontology and Stratigraphy Quartz Spring Area, Inyo County California.* Univ. Calif. Publ. Geol. Sci., vol. 38, n. 2, pp. 89-150, pl. 14-15, fig. 1-18, Berkeley and Los Angeles.

LECOMPTE M., 1952 — *Madréporaires Paléozoiques.* In PIVETEAU J.: *Traité de Paléontologie.* Vol. 1, pp. 419-538, 229 fig., Paris.

LEWIS H. P., 1929 — *On the Avonian Coral Caninophyllum gen. nov. and C. archiaci* (EDWARDS & HAIME). Ann. Mag. Nat. Hist., vol. 10, n. 3, pp. 456-468, pl. XI-XII, London.

MINATO M., 1951 — *Some Carboniferous Corals from Southwestern Japan.* Trans. Proc. Palaeont. Soc. Japan, N.S., n. 1, pp. 1-5,2 fig., Tokyo.

MINATO M., 1955 — *Japanese Carboniferous and Permian Corals.* J. Fac. Sci. Hokkaido Univ., ser. 4, Geol. Min., vol. 9, n. 2, pp. 1-202, pl. 1-43, fig. 1-25, Sapporo.

MINATO M., KATO M., 1967 — *On the Coral Genus Carinthiaphyllum Heritsch, with a Description of Carinthiaphyllum carnicum Heritsch from the Carnic Alps.* J. Fac. Sci. Hokkaido Univ., ser. 4, Geol. Min., vol. 13, n. 4, pp. 313-320, pl. 38, 2 fig., Sapporo.

MOORE R. C., JEFFORDS R. M., 1941 — *New Permian Corals from Kansas, Oklahoma and Texas.* Bull. Geol. Surv. Kansas, vol. 38, pp. 65-120, pl. 1-8, Lawrence, Kansas.

PARKS J. M., 1951 — *Corals from the Brazer Formation (Mississippian) of Northern Utah.* J. Paleont., vol. 25, n. 2, pp. 171-186, pl. 29-33, 3 fig., Tulsa, Oklahoma.

SALÉE A., 1910 — *Contribution à l'étude des polypiers du calcaire carbonifère de la Belgique. Le genre Caninia.* Nouv. Mém. Soc. Belge Géol. Paléont. Hydrol., Sér. 4, Mém. 3, pp. 1-62, pl. I-IX, Bruxelles.

SANFORD W. G., 1939 — *A Review of the Families of Tetracorals*. Amer. J. Sci., vol. 237, pp. 295-323, 401-423, 16 fig., New Haven.

SCHINDEWOLF O. H., 1938 — *Zur Kenntnis der Gattung Zaphrentis (Anthoz., Tetracorall.) und der sogenannten Zaphrentiden des Karbons*. Jb. Preuss. Geol. Landesanst., vol. 58 (1937), pp. 439-454, pl. 44-45, Berlin.

SCHINDEWOLF O. H., 1952 — *Korallen aus dem Oberkarbon (Namur) des oberschlesischen Steinkohlenbeckens*. Akad. Wiss. Lit. Mainz, Abh. Math. Naturw. Kl., n. 4, pp. 145-227, pl. I-II, 29 fig., Mainz.

SCHOUPPÉ A. VON, 1961 a — *Karbon und Perm im Vitanje-Gebirge - Ostkarawanken - NW-Jugoslawien*. Pt. II. *Beschreibung der Korallen-Fauna*. N. Jb. Geol. Paläont., Mh. 7, pp. 354-374, 4 fig., Stuttgart.

SCHOUPPÉ A. VON, 1961 b — *Nachweis von Unterperm in Attika durch Carinthiaphyllum suessi Heritsch 1936*. Ann. Géol. Helléniques, vol. 12, pp. 122-128, pl. XIX, 3 fig., Athènes.

SCHOUPPÉ A. VON, STACUL P., 1959 — *Die Fossula der Pterocorallia, ihre morphogenetische und taxonomische Bedeutung*. N. Jb. Geol. Paläont., Abh., vol. 108, n. 1, pp. 21-46, pl. 4, fig. 1-9, Stuttgart.

SCHOUPPÉ A. VON, STACUL P., 1961 — *Die Axialstruktur der Pterocorallia*. N. Jb. Geol. Paläont., vol. 112, pp. 251-280, pl. 32, fig. 1-10, tab. 1-2, Stuttgart.

SCHOUPPÉ A. VON, STACUL P., 1966 — *Morphogenese und Bau des Skelettes der Pterocorallia*. Palaeontographica, Suppl., vol. 11, pp. 1-186, pl. 1-6, 132 fig., 8 tab., Stuttgart.

SOŠKINA E. D., 1960 — *Turnejskie Korally Rugosa i ich vzaimootnošenija s Devonskimi. Komi filial AN SSSR*. Sb. trudov po geol. i paleontol., pp. 272-351.

SOŠKINA E. D., DOBROLJUBOVA T. A., PORFIR'EV G. S., 1941 — *Permskie Rugosa Evropejskoj casti SSSR*. Paleontologija SSSR, vol. 5, n. 3, pp. 1-304, pl. I-LXIII, 44 fig., Moskva - Leningrad.

SOŠKINA E. D., KABAKOVIČ N. V., 1962 — *Podotrjad Streptelasmatina*. In SOKOLOV B. S.: *Gubki, Archeociaty, Kisecnopolostnye, Cervi*. Osnovy Paleontologii, vol. 2, pp. 317-324, Moskva.

SUTHERLAND P. K., 1958 — *Carboniferous Stratigraphy and Rugose Coral Faunas of Northeastern British Columbia*. Geol. Surv. Canada, Mem. 295, pp. 1-178, pl. I-XXXIII, Ottawa.

THOMSON J., 1883 — *On the Development and Generic Relation of the Corals of the Carboniferous System of Scotland*. Proc. Philos. Soc. Glasgow, vol. 14, pp. 296-502, pl. 1-4, Glasgow.

TOLMAČEV I. P., 1924, 1931 — *Nižnekamennougol'naja Fauna Kuzneckogo uglenosnogo bassejna*. Geol. kom. Materialy no obscej i prikladnoj geologii, vol. 25, 643 pp., 23 pl.

WU WANG SHIH, 1964 — *Lower Carboniferous Corals in Central Hunan*. Mem. Inst. Geol. Paleont. Acad. Sinica, n. 3, pp. 1-100, pl. 1-16, 5 fig., 5 tab., Peking.

YAMAGIWA N., 1961 — *Amygdalophyllum sp. from Hyogo Prefecture, Japan*. Trans. Proc. Palaeont. Soc. Japan, N.S., n. 44, p. 152, fig. 1.

YAMAGIWA N., 1962 — *The Permo-Carboniferous Corals from the Atetsu Plateau and the Corals Faunas of the Same Age in the Southwest Japan*. Mem. Osaka Univ. Liberal Arts Educ., ser B. nat. Sci., n. 10, pp. 77-114, pl. 1-8, Osaka.

YÜ C. C., 1933 — *Lower Carboniferous Corals of China*. Palaeont. Sinica, ser. B. vol. 12, n. 3, 133 pp., 24 pl., Peiping.

ZUKALOVÁ V., 1961 — *Spodnokarbonská korálová fauna z okoli Hranic a z valounu karbonskych slepencu v okoli Brna*. Sborn. Geol. Ustrednino Ustavu, oddil paleont., vol. 26, pp. 317-356, pl. 1-6, Praha.

TRIASSIC FOSSILS

UPPER TRIASSIC PLANTS FROM THE KALAWCH RIVER, NORTH-EAST AFGHANISTAN

by

P.D.W. BARNARD

Botany Department, University of Reading

Introduction — The four species described in this paper were collected by Eng. R. Varvelli during the Italian Expedition (1965) to Hindu Kush in North-East Afghanistan. The author was invited by Prof. A. Desio to examine and describe the specimens on the nine rock samples for the present volume.

Locality — An outcrop of black shales in the valley of the Kalawch River, east of Faydzabad, Badakhshan. Geographical co-ordinates: 70° 49' 33" East, 36° 14' 10" North.

The rock is a hard fine-grained dark grey slatey shale and contains the imprint or impression of plant leaves. There is no plant substance remaining in any of the specimens so that it has not been possible to investigate epidermal structure by means of cuticle preparations. The impressions however reveal the macroscopic morphology of the leaves very well. The nine rock samples contain the fragmentary remains of twenty separate leaves of four species as follows:

Pterophyllum filicoides (Schlotheim) Thomas	7
Pterophyllum kalawchiense Barnard	9
Otozamites ashtarensis Barnard	2
Taeniopteris pseudobrevis Barnard	2

The specimens are deposited in the collections of the Institute of Paleontology at the University of Milan.

Historical sketch — In Afghanistan, Mesozoic fossil plants were first discovered by Griesbach between 1884 and 1886 in the deep and spectacular valleys of the Saighan region to the west of Kabul on the north side of the Hindu Kush. In this region the rivers have cut through the Cretaceous limestones and into the Jurassic and older rocks below. West, in Jacob and Shukla (1955) describes the geology of this region where a considerable thickness of continental strata are exposed. Briefly there is a mixed volcanic and sedimentary Doab series, possibly of Triassic age succeeded unconformably by the Saighan series 4,000 ft. (1,220 m) thick. It is this series of sandstones, shales and coal seams which has yielded the fossil plants. The Saighan series is overlain conformably by the Red Grit series which are again overlain unconformably by Cretaceous limestones. Plant fossils have been collected from three valleys in this region by Hayden (1909), Furon (1923), Fox (1936), Ahmad (1940-42), Rosset (1946-49) and more recently by Weippert of the German geological mission. Other members of this mission collected plants from localities outside the original Saighan area: Ga-

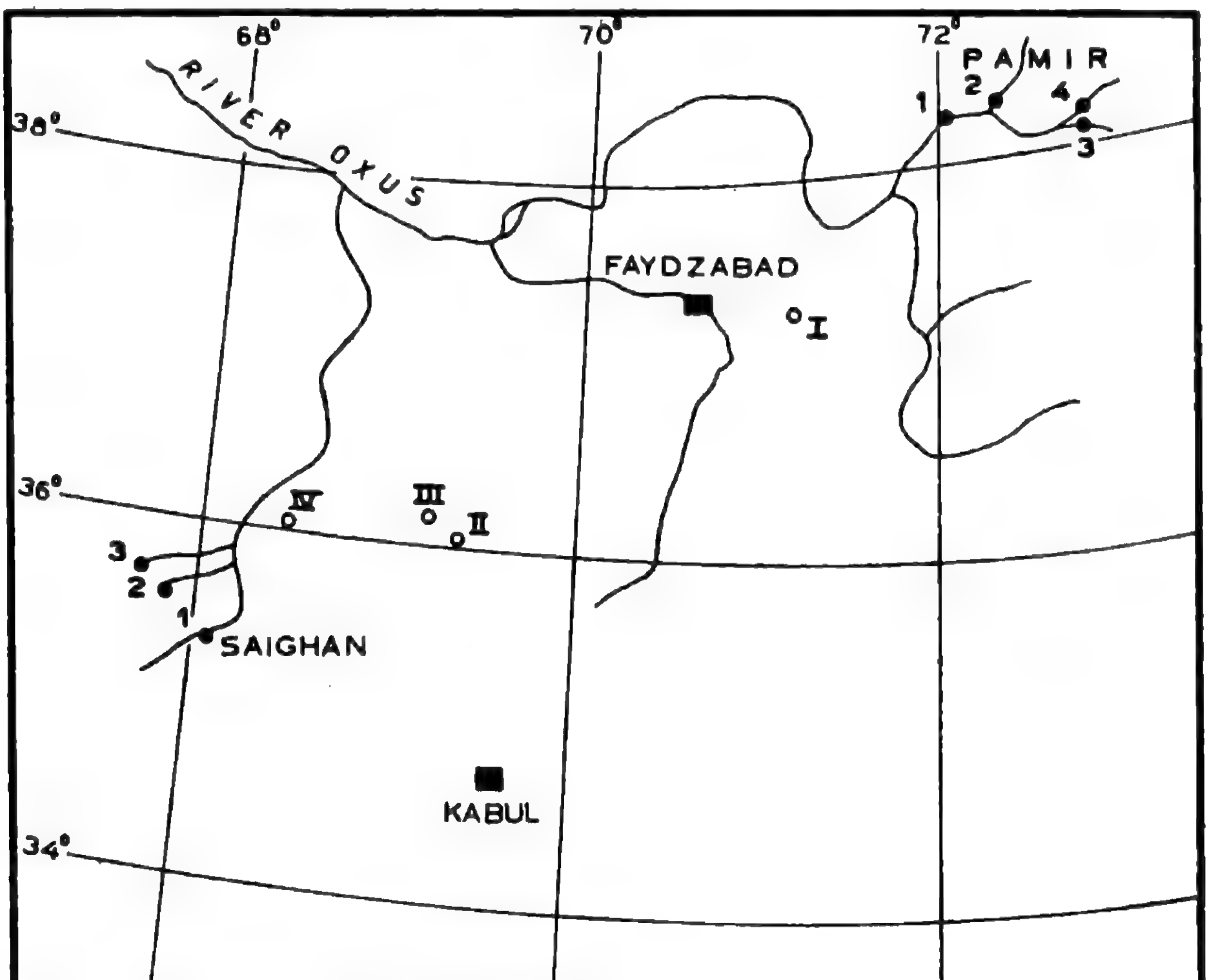


Fig. 1 - Mesozoic plant localities in Afghanistan and Pamir. Saighan series - Middle Jurassic. 1, *Ishpushta* (*Darra-i-Surkhab*). 2, *Chehil* [*Chail*] (*Darra-Andrak*). 3, *Darra-i-Suf* (*Dahan-i-Tar*). New Saighan series localities. II, *Zamburak*. III, *Takatoymast*. IV, *Karkar* (*Dud-Kash*). I, Kalawch River - Upper Triassic. Pamir - Upper Triassic. 1, *Bartang River*. 2, *Kudara River*. 3, *Zap Pshart River*. 4, *Kokui-bel-si River*.

bert from Karkar (Dud Kash) and Hinze from Zamburak, Takatoymast and Kona Queslag.

In the Pamir just to the north of Afghanistan Mesozoic plants have been collected by the Russian expeditions of 1928 and 1932 by Yudin and others. Yudin describes the sediments as comprising an igneous series succeeded by a sedimentary series of continental origin containing the plant beds.

The Saighan series contains a flora determined as Bajocian-Bathonian with the genera *Klukia, Coniopteris, Eboracia, Ptilophyllum, Brachyphyllum* and *Pagiophyllum*; Seward (1912), Sitholey (1940), Boureau et al. (1950), Jacob and Shukla (1955), and Benda (1964). The Pamir flora with fourty one species was determined by Prynada (1934) as Upper Triassic. Some of the plants point strongly to the Keuper; these are *Equisetites arenaceous*, and *Pterophyllum filicoides*. This last determination was not given by Prynada but is my identification of his figures of *Pterophyllum aequale*, *P. andreanum*, *P. propinquum* and *P. pshartense*. His flora also includes specimens determined as *Pterophyllum bavieri* (Tonkin flora, Rhaetian of Zeiller, 1903 and Shemshak flora regarded as Lower Lias, Barnard, 1967), *Clathropteris meniscoides* which is much confused with other species is realiably determined from the Rhaetian and Lower Lias, *Nilssonia brevis* only reliable from the Lower Lias. The specimens were collected from twenty nine localities in four separate valleys and the combined stratigraphic range of the species considered is from the base of the Keuper to the Lower Lias. In Sikstel (1960) the Upper Triassic deposits of the Pamir are said to contain three separate floral assemblages, Karnian, Norian and Rhaetian as recognised by Koshlin and *Pterophyllum pshartense* is reported from all of them. The specimens Sikstel figures as *P. pshartense* are stated to be from the Norian of the Bartang river.

The age of the black shales on the Kalawch river — This region is a highly disturbed one geologically and the age of the shales was not proved in the field. In the vicinity of the shale outcrop there were found limestones of Devonian and Jurassic age. Out of the four species described here, two give an indication of the age of the bed. *Pterophyllum filicoides* (synonyms *Pterophyllum jaegeri*, *P. longifolium* and *P. brevipenne*) is widely distributed in the Lettenkohle and the Schilfsandstein of the Keuper (Upper Ladinian and Karnian) in southern Germany, the Middle Keuper (Karnian) in Switzerland and Austria. This species has not been recorded from any of the Rhaetian floras of Germany, Sweden or Greenland so that I believe it to have died out in Europe before the end of the Norian and to have flourished in the Karnian. In the Pamir *P. filicoides* (synonym *P. pshartense*) ranges from the Karnian to the Rhaetian. The other plant, *Otozamites ashtarense* is a newly described species from the Lower Lias of the Elburz in northern Iran. Its range is unknown so that it is possible that it started in the

Upper Triassic. Upon this evidence I suggest an Upper Triassic age for this shale flora. It has one species in common with at least some of the beds in the Pamir and is considerably older than the Saighan series.

PALEONTOLOGICAL DESCRIPTIONS

Class Spermatophyta

Order Bennettitales

Families Incertae sedis

Genus **Pterophyllum** Brongniart, 1828

Pterophyllum filicoides (Schlotheim) Thomas, 1930

Pl. 4, fig. 1; pl. 5, fig. 2, 4; text-fig. 2 A to I; text-fig. 3 F, G.

Middle Keuper (Karnian): Neue Welt, (Basel) Switzerland.

1822 *Algacites filicoides* Schlotheim, p. 46, pl. 4, fig. 2.
1828 *Pterophyllum longifolium* Brongniart, p. 95. Name for Scholotheim's leaf.
1864 *Pterozamites brevipennis* Kurr m.s. Schenk, p. 115, pl. 5, fig. 1.
1865 *Pterophyllum longifolium* Brongniart. Heer, p. 52, pl. 3, fig. 6.
1865 *Pterophyllum Jaegeri* Brongniart. Heer, p. 52, pl. 3, fig. 2.
1865 *Pterophyllum brevipenne* Kurr. Heer, p. 52, pl. 3, fig. 1.
1877 *Pterophyllum Jaegeri* Brongniart. Heer, p. 79, pl. 31, fig. 1-4; p. 132, fig. 1, 2.
1877 *Pterophyllum longifolium* Brongniart. Heer, p. 80, pl. 30, fig. 7, 8; pl. 33, fig. 1-5 (not fig. 6-8); pl. 35, fig. 1-3; pl. 36, fig. 1, 2.
1877 *Pterophyllum brevipenne* Kurr. Heer, p. 82, pl. 34, fig. 1-8; pl. 36, fig. 3.
1903 *Pterophyllum Jaegeri* Brongniart. Leuthardt, p. 14, pl. 5, fig. 1-3; pl. 6, fig. 1, 2; pl. 10, fig. 1.
1903 *Pterophyllum longifolium* Brongniart. Leuthartdt, p. 17, pl. 5, fig. 4, 5; pl. 6, fig. 3; pl. 7, fig. 1-3; pl. 8, fig. 1, 2; pl. 9, fig. 1, 2; pl. 10, fig. 2, 5.
1903 *Pterophyllum brevipenne* Kurr. Leuthardt, p. 19, pl. 5, fig. 8, 9; pl. 10, fig. 4.

Lettenkohle and Schilfsandstein (Upper Ladinian & Karnian): Baden and Wurttemberg, Germany.

1827 *Osmundites pectinatus* Jaeger, p. 29, pl. 5, fig. 6; pl. 7, fig. 1-5.
1828 *Pterophyllum Jaegeri* Brongniart, p. 95. Name for Jaeger's leaf.
1865 *Pterophyllum Jaegeri* Brongniart. Schoenlein & Schenk, pl. 18, pl. 13, fig. 1-4.
1822 *Pterophyllum Jaegeri* Brongniart. Frentzen, p. 46, pl. 3, fig. 6; pl. 4, fig. 1, 3, 4.
1922 « *Pterophyllum Jaegeri longifolium* » Frentzen (= *Pterophyllum longifolium* Brongniart), p. 50; pl. 4, fig. 5, 6.

1922 « *Pterophyllum Jaegeri brevipenne* » Frentzen (= *Pterozamites brevipennis* Kurr), p. 55; pl. 3, fig. 10.

Keuper (? Karnian): Lech Thal, Austria.

1853 *Pterophyllum Jaegeri* Brongniart. Heer, p. 129, pl. 7, fig. 7, 8.

Keuper (Karnian): Lunz, Austria.

1921 *Pterophyllum longifolium* Brongniart. Kräusel, p. 203, pl. 9, fig. 6 b; pl. 11, fig. 1-3; text-fig. 4.
1930 *Pterophyllum filicoides* (Schlotheim) Thomas, p. 406, pl. 20, fig. 3-5; tex-fig. 13.
1943 *Pterophyllum* sp. Kräusel, pl. 5, fig. 9.

Upper Triassic: Pshart and other rivers (Pamir), Tajikistan.

1934 *Pterophyllum aequale* non Brongniart. Prynada, p. 33, pl. 2, fig. 1; tex-fig. 5.
1934 *Pterophyllum Andraeanum* non Schimper. Prynada, p. 38, pl. 5-6, fig. 5; (not. pl. 3, fig. 4 or pl. 5-6, fig. 10).
1934 *Pterophyllum propinquum* non Goeppert. Prynada, p. 40, text-fig. 7-9.
1934 *Pterophyllum pshartense* Prynada, p. 43, pl. 8, fig. 1; pl. 9, fig. 1; pl. 10, fig. 6; pl. 11, fig. 3.
? 1934 *Pterophyllum sasykense* Prynada, p. 46, pl. 8, fig. 4, 5.
? 1934 *Pterophyllum angustilobum* Prynada, p. 44, pl. 2, fig. 5; pl. 4, fig. 4, 5.
1960 *Pterophyllum pshartense* Prynada. Sikstel, p. 76, pl. 11, fig. 2, 3, (not fig. 4, leaf with contiguous falcate pinnae).

I do not accept the following specimens.

1855 *Pterophyllum longifolium* non Brongniart. Andrae, p. 41, pl. 10, fig. 1, a *Pterophyllum* leaf 9 cm wide with conspicuous transverse wrinkles on a narrow rachis only 2 mm wide diagnosed by Schimper (1870) as *Pterophyllum Andreanum*. Lias, Germany.
1874 *Pterophyllum longifolium* non Brongniart. Compter, p. 7, pl. 1, fig. 2, 3, 4, with long pinnae up to 30 cm diagnosed in 1894 by Compter as *Pterophyllum robustum*. Keuper, Germany.
1922 « *Pterophyllum Jaegeri Blumi* » Frentzen (= *Pterozamites Blumi* Schenk), p. 49, pl. 4, fig. 2, a *Pterophyllum* leaf with straight sided contiguous pinnae. Keuper, Germany.

Emended diagnosis — Leaf once imparipinnate, petiolate, blade typically elliptic in outline. Size extremely variable, large leaves up to 60 cm long by 12 cm wide, small leaves from 8-12 cm long by 2 cm wide. Rachis typically showing coarse (c. 0.2 mm) longitudinal striations, rarely smooth, never showing transverse wrinkles; up to 6 mm wide. Petiole longitudinally striate, less than one fifth the length of the blade (up to 6.5 cm long); petiole base expanded, bulbous, twice as wide as the base of the rachis. Pinna shape very varied, strap like with parallel margins to cuneate. Typical pinna in the middle of the leaf straight, parallel sided, length about ten times the width, up to 56 mm long by 5.5 mm wide; pinna width constant for four fifths of their length, apex obtuse contracting only in the terminal 2-4 mm; pinna slightly constricted just above the base, narrowest at about 2 mm from the rachis; base expanded along the edge of the rachis and confluent with adjacent pinnae. Pinnae alternate to subopposite, attached along the lateral margin of the rachis. Pinnae separate, lateral margins of adjacent pinnae separated by a sinus up to 3 mm wide, pinnae rarely crowded and contiguous. Pinnae at an angle of 70°-90° to the rachis. Veins fine parallel 8-16 per pinna, not depressed, simple or dichotomising once within the basal third of the pinna usually near the rachis; density above region where veins fork c. 40 per cm.

Leaf amphistomatic. Adaxial cuticle stiff, 2-3μ thick. Upper epidermis of pinna composed of regular rows of elongate hexagonal cells, anticlinal walls straight 2μ thick. Cells between veins nearly isodiametric, cells over veins half as wide and twice as long. Cells 20-150μ long by 15-50μ wide. Stomata transversely orientated only between the veins in the basal region of the pinna, about 30 per mm^2 near the base decreasing upwards and absent from the ultimate third of the pinna. No trichomes or papillae. Abaxial cuticle delicate, 1-2μ thick. Lower epidermis of pinna similar to the upper, cells rectangular; anticlinal walls undulate, thickening irregular 1μ or less. Cells between veins nearly isodiametric, cells over veins half as wide and twice as long, in 3-5 rows. Cells 20-130μ long by 20-50μ wide. Stomata transversely orientated only between the veins, absent from a strip 0.2 mm wide along the pinna edge. Stomatal density typically about 100 per mm^2. Subsidiary cell pair occupying an area equal to that of a normal epidermal cell, 40-80μ long by 40-50μ wide not papillate, cuticle not thickened. Guard-cell dorsal cuticles thickened, only half covered by the subsidiary cell, 28-32μ wide at right angles to the stoma. Stoma c. 12μ long. Trichomes unicellular, clavate 25-50μ long by 15-25μ in diameter, on round to elliptical bases 8-16μ in diameter. Trichomes scattered over and between the veins, absent from the stomatal free strip 0.2 mm wide along the pinna edge. Density 160 per mm^2.

Diagnosis, external form based on Schlotheim (1822), Heer (1877) and Leuthardt (1903) and epidermal structure on Thomas (1930) and my own observation of fresh cuticles prepared from a Lunz specimen in the Thomas collection.

Holotype — Schlotheim specimen pl. 4, fig. 2.

Stratum typicum — Middle Keuper (Karnian).

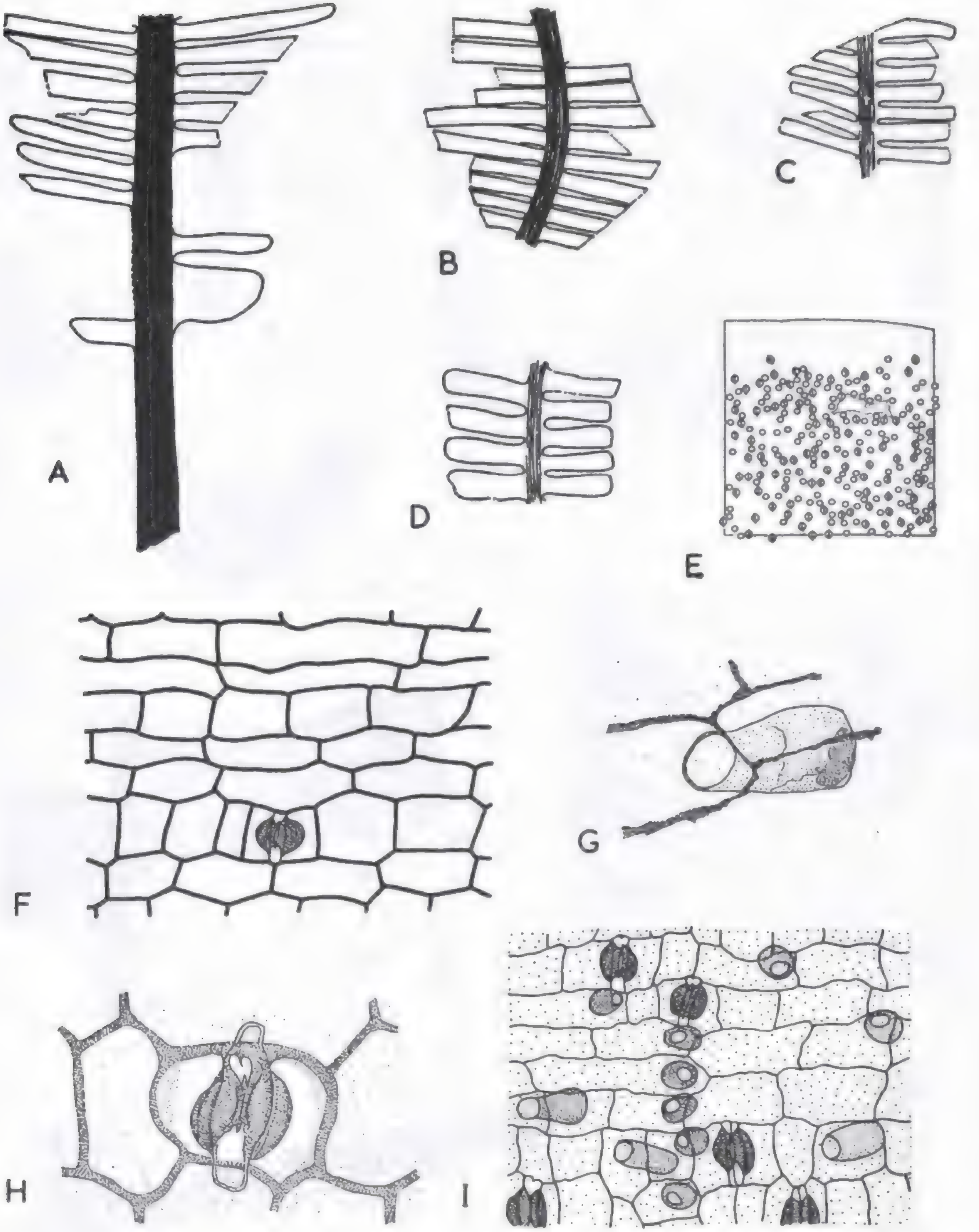


Fig. 2 - *Pterophyllum filicoides* (Schlotheim). A, C and D portions of leaves from Kalawch river nos. 1, 2, 5; × 1. A. Showing, the short broad basal pinnae typical of the « *P. brevipenne* » form of this species. B, E-I Lunz specimens, British Museum (Natural History) no. V 52786 a & b. B. Fragment of a leaf, tips of pinnae missing for comparison with Kalawch specimens; × 1. E. 1 mm² of lower epidermis with the edge of the pinna at the top showing distribution and orientation of stomata and trichomes o. F. Upper epidermis with cells over veins along the top side of the drawing; × 200. G. A trichome from over a vein on the lower side of leaf; × 500. H. Stomata from upper side of leaf; × 500. I. Lower epidermis with cells over vein running across the centre of the drawing; × 200.

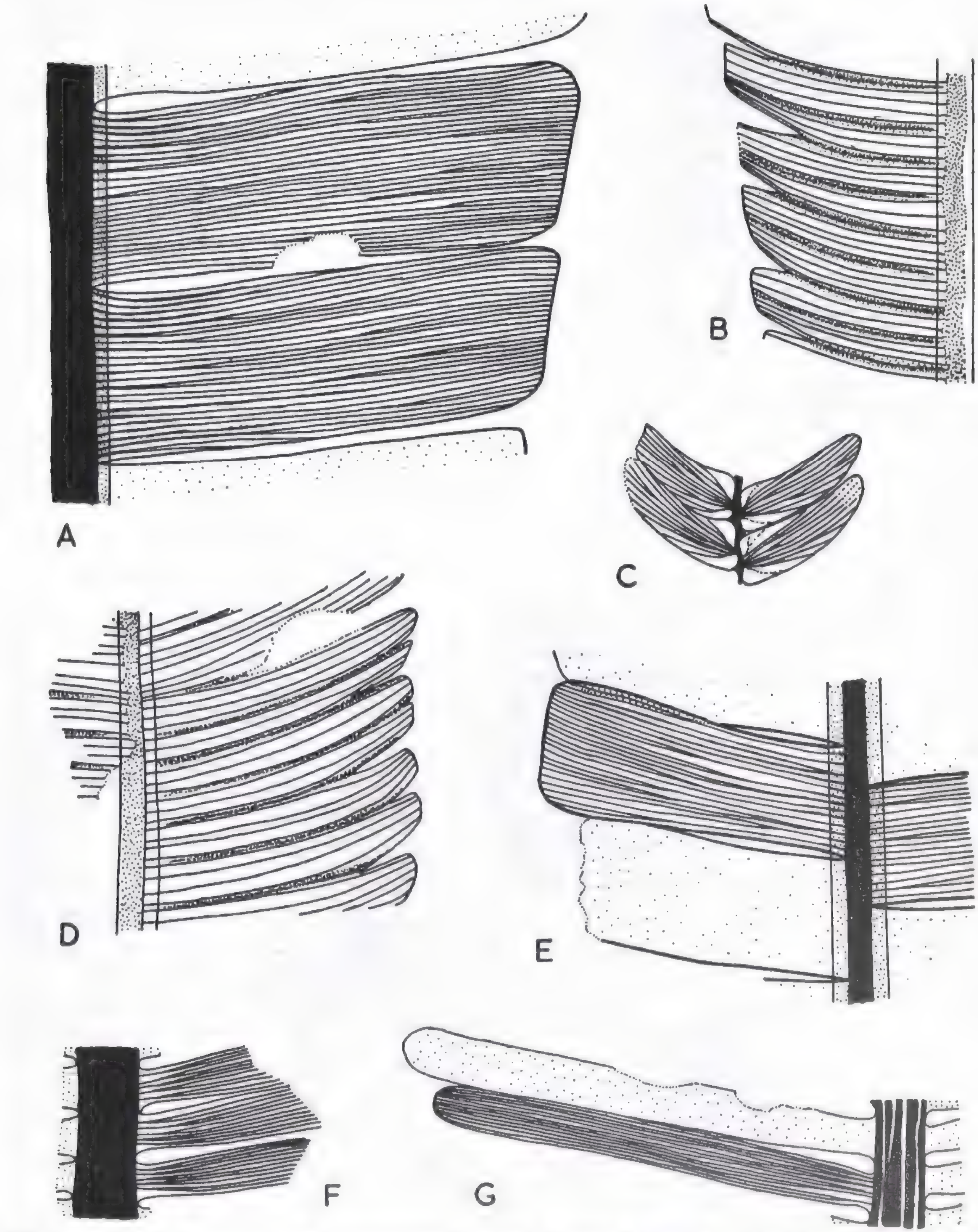


Fig. 3 - A and E. *Pterophyllum kalawchiense* Barnard. Pinnae to show shape and venation. A. Holotype no. 9, E. Paratype no. 8. B and D. *Taeniopteris pseudobrevis* Barnard. Portion of the lamina to show attachment to rachis, corrugations, veins and incised marginal segmentation. Holotype no. 7. C. *Otozamites ashtarense* Barnard. Four pinnae from the center of the specimen to show shape and venation (the basal veins could not be seen). Specimen no. 6. F and G. *Pterophyllum filicoides* (Schlotheim). F. Part of a Lunz specimen to show bases of pinnae and their venation. British Museum (Natural History) no. V 52786. G. Typical pinnae from the large Kalawch river specimen (« *P. longifolium* » form) one showing the veins. Specimen no. 1.

All × 2

Locus typicus — Neue Welt.

Description — The seven specimens from the Kalawch river exhibit considerable variation as is shown by the three examples illustrated. Fine parallel veins are to be found in all, the basal dichotomies of the veins however are seen only in a few pinnules, one of which is shown in text-fig. 3 G. The largest specimen possesses an abnormally short and broad basal pinnule.

A rock specimen from Lunz belonging to the Thomas collection showed a number of small specimens of *Pterophyllum filicoides* leaves as well as some *Nilssoniopteris* leaves and a fine specimen of *Bennetticarpus wettsteini* (Krasser). The *Pterophyllum* cuticles I prepared by normal maceration (conc. HNO_3 + $NaClO_3$) gave good clear preparations of the upper cuticle without further treatment. The details of the lower cuticle could only be seen after the cuticle had been treated in hydrofluoric acid. The cuticle was then stained in safranin which helped to differentiate the trichomes which are figured here for the first time.

Discussion — The leaf fragment figured by Schlotheim in 1822 is 11 cm long, it has a striated rachis 4.5 mm wide with laterally attached pinnae. The pinnae have their bases expanded and in contact, they are constricted just above the base then expanded slightly and are parallel sided but their tips are missing. The stumps of the pinnae measure up to 45 mm in length by 6 mm in width and are separated by sinuses 3 mm wide. There are about twelve simple veins drawn in each pinna.

Jaeger in 1827 gave clear figures of leaf fragments, some of them (pl. 7, figs. 1, 2) are nearly complete small leaves. The pinnae in some of the specimens are separate, in others contiguous; the rachises are either striated, with a single ridge or smooth. A wide range of specimens have been referred to one or other of the two specific names Brongniart applied to Schlotheim and Jaeger's leaves in 1828 but most of the variants of subsequent authors can be matched in the original figures.

In 1864 Schenk described a small leaf 8 cm long by 14 mm wide from Neue Welt as *Pterozamites brevipennis* Kurr. Subsequently Heer and Leuthardt assigned their specimens to the three species; *P. jaegeri* large leaves often with straight edged contiguous pinnae, *P. longifolium* narrower leaves often with separate pinnae showing a constriction in the basal region, *P. brevipenne* small narrow leaves. Frentzen (1922) united these three species together with two others, *P. blumi* Schenk and *P. robustum* Compter in one species *P. jaegeri* but retaining the specific epithets as varietal names of *P. jaegeri*.

I accept that *P. jaegeri*, *P. longifolium* and *P. brevipenne* constitute one species. I think the other two species are distinct, Schenk's original figure of *P. blumi* shows a leaf 5 cm wide with straight sided contiguous or imbricate pinnae with decurrent bases. Similarly the pinnae in Frentzen's specimen have straight sides and are contiguous, their bases are not very clearly shown. A typical leaf of *P. filicoides* has pinnae with a slight constriction in the basal region just separate from one another. *P. robustum* Compter is a much larger leaf, its pinnae are said to be 30 cm long by 8 mm wide. The oldest name for this group of species being that of Schlotheim I have followed Thomas and used it here.

A number of the *Pterophyllum* species figured by Prynada in 1934 from the Pshart and other river valleys in the Pamir are I think identical with the group of European Triassic leaves discussed here. The figures of the *P. pshartense* leaves show the following features typical of *P. filicoides*; laterally attached, separate pinnae with their bases in contact, the pinnae show a basal constriction and are ten times as long as they are wide. The specimens called *P. aequale*, *P. andreanum*, *P. propinquum* all have long narrow laterally attached pinnae on strongly striated rachises and resemble specimens figured by Heer and Leuthardt from Neue Welt more closely than typical leaves of the species to which they are attributed. Sikstel (1960) figured from the Bartang river three specimens as *P. pshartense*, one (pl. 11, fig. 2) with basally constricted pinnae typical of *P. filicoides*. Sikstel included as synonyms of *P. pshartense* Prynada's species *Pterophyllum sasykense* and *P. angustilobum*. These leaves as described by Prinada are very similar to *P. filicoides*, but his figures are not very clear.

The new specimens from the Kalawch River figured here fall naturally into two groups, large leaves like *P. longifolium* and *P. pshartense* and smaller narrower leaves like *P. brevipenne*. They show the following features which suggest their identity with *P. filicoides*: striated rachis, laterally attached separate pinnae with contiguous bases, a slight constriction in the basal region of the pinna, typical pinnae as in text-fig. 3 A, with parallel sides, rounded tips and about ten times as long as they are broad; the venation, there being about twelve parallel veins in each pinna which arise in pairs from the rachis.

In 1921 Kräusel figured for the first time the cuticle of this species. In his figure (pl. 3, fig. 3) of the 'lower epidermis' one can see the trichomes described here. His specimens come from the Keuper near Lunz in Austria and were figured as *P. longifolium*. A leaf he figured (pl. 9, fig. 6 at b) shows the characteristic constriction in the basal region of the pinnae and the striated rachis. His best figure (1943, pl. 5, fig. 9) of a leaf of this species is in a later paper on the Lunz flora. Thomas (1930) figured the cuticles of *P. filicoides* as he called the Lunz leaves. He stated that there were leaves in the Lunz collections which would fall into the specific groups *P. jaegeri*, *P. longifolium* and *P. brevipenne*. The epidermal structure of all the leaf types were similar so he united them into one *P. filicoides* (Schlotheim). He did not see the free trichomes but only their bases but this may only have been due to differences in preparing the cuticle.

Pterophyllum filicoides is closely related to the Rhaetian *P. astartense* Harris, 1932. The rachises of both species are striated (longitudinal furrows) and have lateral pinnae. The shape of the pinnae in *P. astartense* varies greatly, but typically they are elliptic and broadest at about half their length, the pinnae are at an angle of about 70° to the rachis. Typical pinnae in *P. filicoides* are strap-like, parallel sided not elliptic and are usually at an angle of about 80° to the rachis. The cuticles of both these species are very similar.

P. astrartense is hypostomatic, *P. filicoides* is amphistomatic. In *P. astartense* the trichomes are like large spherical papillae some 30μ in diameter. The trichomes in *P. filicoides* are clavate up to 50μ long by 25μ in diameter. The stomata are similar but the subsidiary cells in *P. filicoides* do not have a noticeably thicker cuticle than the surrounding epidermal cells.

Pterophyllum kalawchiense Barnard, 1967

Pl. 4, fig. 2; text-fig. 3 A, E

1967 *Pterophyllum kalawchiensis* Barnard, p. 723, pl. 60, fig. 1-3.

Material — Holotype pl. 4, fig. 2, no. 9 a+b: paratypes other specimens nos. 8, 9.

Stratum typicum — Black shales; possibly Upper Triassic.

Locus typicus — Kalawch River, east of Faydzabad, Badakhshan, North-East Afghanistan.

Derivatio nominis — The specific name relates to the type-locality.

Diagnosis — Leaf once pinnate (largest incomplete specimen 27 cm long by 10 cm wide). Rachis smooth, not showing striations or wrinkles; up to 4 mm wide. Pinnae from the middle region of the leaf nearly rectangular, length about three times the breadth, up to 50 mm long by 17 mm wide; pinnae width nearly constant for four fifths of their length; apex truncate, distal portion of pinnae occasionally expanded, acroscopic margin being more deflected than the basiscopic; base of pinna expanded at attachment and confluent with adjacent pinnae. Pinnae alternate to subopposite, attached along the adaxial surface of the rachis about half way between the midline and lateral margin of the rachis. Pinnae with lateral margins separated or contiguous, where pinna tips are expanded they may overlap. Pinnae at an angle of c. 85° to the rachis. Veins conspicuous, strongly depressed, parallel, simple or dichotomising once rarely twice; dichotomies occurring throughout the length of the pinna; density at rachis c. 20 per cm, at apex of pinna c. 30 per cm.

(Type specimens are impressions with no leaf substance preserved. Epidermal structure not known).

Description — There are fragments of nine leaves of this species preserved on two rock samples. I have designated as holotype the largest and clearest specimen on block no. 9. Apart from size there is little variation, the tips of the pinnae in one specimen text-fig. 3 E are wider than the base. In some others the pinnae are convex above so that the lateral margins dip into the rock. The apices of these pinnae are more rounded and the sinuses separating adjacent pinnae appear greater than they would be if the pinnae were preserved flat.

Discussion — The pinnae of this leaf being longer than they are broad suggest the genus *Pterophyllum* rather than *Anomozamites*. Large numbers of species have been described for both genera but these leaves do not agree with any so well as to indicate specific identity. These leaves may be compared with *Pterophyllum schenki* Zeiller and *P. inconstans* (Braun) which are the species which they most closely resemble. *P. schenki* is distinguished as a narrower leaf up to only 5 cm wide with pinnae attached laterally to the rachis which shows well developed transverse wrinkles. In *P. kalawchiensis* the leaves are up to 10 cm wide with adaxially attached pinnae on a smooth rachis. *P. inconstans* also has adaxially attached pinnae but it is a narrower leaf up to 4 cm wide and has transverse wrinkles on the rachis.

Genus **Otozamites** Braun, 1842

Otozamites ashtarense Barnard, 1967

Pl. 5, fig. 3; text-fig. 3 C

Lias — Ashtar (Elburz Mountains) Northern Iran.

1950 *Otozamites abbreviatus* (non Feistmantel) Boureau, p. 228, pl. 8, fig. 42, 43.
1950 *Ptilophyllum cutchense* (non Morris) Boureau, p. 231, pl. 7, fig. 36, 40.
1967 *Otozamites ashtarense* Barnard, p. 566, pl. 47, fig. 7, 8; pl. 48, fig. 1; text-fig. 3 A, C, D.

Diagnosis — Leaf small once pinnate, outline lanceolate, width 6-20 mm (full length unknown, longest specimen 9 cm nearly complete). Rachis smooth, narrow, as seen from above c. 0.5 mm wide (petiole not known). Pinnae variable; long, slender and falcate to short, broad and rhomboidal; broadest at the base, tapering to the apex. Pinnae alternate to subopposed attached by one third of the base, near to the midline on the upper side of the rachis. Pinna base on either side of its attachment very slightly reflexed towards midline of the rachis. Distal (i.e. acroscopic) side of pinna base typically forming a forward projecting lobe up to 0.5 mm wider than the pinna limb. Proximal side of pinna base rounded. Distal margin beyond the basal lobe concave, curving forward to from 70° to 40° to the rachis. Proximal margin strongly convex meets the distal margin at 50°. Ultimate tip of pinna rounded. Pinnae separate except for the contiguous to imbricate basal lobe. Pinnae typically 9 by 3 mm, up to 11 mm long by 1.5-3.5 mm wide at the base. Veins typically seven, 6-8 enter the base of each pinna, radiating, dichotomise one or two times, marginal density 14 per cm.

(Epidermis. Structure not determined, cuticle not prepared).

Holotype — (63) 1A-S6 no. 4.

Stratum typicum — Shemshak Formation.

Locus typicus — Ashtar.

Description — There are two fragments of this leaf, one is shown in pl. 5, fig. 3 the other is a very faint immage on rock specimen no. 5. It is best seen when the rock is immersed in xylol.

Discussion — The small fragment of an *Otozamites* leaf shown in pl. 5, fig. 3, may be identified with *O. ashtarense* from Iran in respect of the following points. The narrowness of the leaf, it is only 18 mm wide. The smooth slender rachis almost completely covered by the bases of the alternate pinnae. The falcate pointed pinnae with a slight foward projecting basal acroscopic lobe. The venation, there are between 6 and 8 veins entering the base of the pinna and they dichotomise once on their way to the margin. This leaf may be compared with *O. indosinensis* Zeiller from Tonkin. *O. indosinensis* is however a slightly larger leaf with straight pinnae up to 13 mm long by 5 mm wide and each has nine veins entering its base. In these leaves from Afghanistan the pinnae are falcate and measure only 9 by 3 mm and to not show more than eight veins in the pinna base. The linear fragment of a leaf figured by Prynada from the Pamir as *O. abbreviatus* Feistmantel is distinguished by the shape of its pinnae which are short, broad and rhomboidal 6 by 4 mm.

Order Incertae sedis

Genus **Taeniopteris** Brongniart, 1828

Taeniopteris pseudobrevis Barnard, 1967

Pl. 5, fig. 1, 4; text-fig. 3 B, D

1967 *Taeniopteris pseudobrevis* Barnard, p. 725, pl. 61, fig. 1-4.

Material — Holotype pl. 5, fig. 1, no. 7; paratype no. 5

Stratum typicum — Black shales; possibly Upper Triassic.

Locus typicus — Kalawch River, east of Faydzabad, Badakhshan, North-East Afghanistan.

Derivatio nominis — The specific name refers to the similarity this leaf shows to *Nilssonia brevis.*

Diagnosis — Leaf simple, outline elongate elliptic; length exceeding 20 cm width 5 cm. Midrib depressed, smooth, 2 mm wide, full width only exposed where lamina is broken away. Lamina attached to the adaxial surface, about two thirds of the distance in from the margin towards the midline of the midrib. Lamina inciso-segmented, adaxially convex and bending down towards the margin, firm, with regular corrugations every 2-3 mm running falcately from midrib to margin. Margin incised, major incisions occurring along line of alternate folds, depth up to one sixth the width of the blade normally only half as deep, 2-6 mm; minor incisions occurring along the line of some of the other folds at the tips of the segments between the major incisions. Teeth or free segments along leaf margin trapezoid, lateral edges inclined towards truncate tip. Veins simple, not depressed, arising at 80°-90° to the midrib at a density of 14 per cm, curving forward to meet the margin at an angle of 50°-60° as measured from the midrib.

(Type specimens are impressions with no leaf substance preserved. Epidermal structure not known).

Description — There are two specimens of this new species, the large nearly complete leaf and the smaller fragment. In both the conspicuous features are the corrugated lamina, the depressed midrib and the incised margin.

Discussion — The specimens are described here as a new species of *Taeniopteris* as it is not possible to assign them to any Botanical order. They may be compared with *Nilssonia brevis* Brongniart from the Hör sandstone in Sweden and the similar leaves *N. fragilis* and *N. incisoserrata* Harris from Greenland. Prynada (1934) figured leaves determined as *N. brevis* from the Pamir and Benda (1964), has figured leaves from Karkar in Afghanistan as *Nilssonia* sp. which are very like *N. brevis.* The specimens described here do not show the attachment of the lamina to the upper surface of the midrib in the midline as is typical of the genus *Nilssonia.* I consider that about one third of the upper surface of the midrib was exposed. There is some difficulty in deciding this because much of the lamina clearly broke away along the midrib where the rock was cleaved but the best preserved parts do indicate exposure.

Acknowledgements — I should like to thank Professor A. Desio of the Institute of Geology, Milan University for sending me these specimens for description. The map and photographs for the plates accompanying this paper were prepared in Milan. Mr. Harvey librarian in the Palaeontology library of the British Museum (Natural History) for help with the early literature on *Pterophyllum filicoides.*

References cited

Andrae K. F., 1855 — *Beiträge zur Kenntniss der fossilen Flora Siebenbürgens und des Banates.* Abh. K. K. Geol. Reichsanst., Bd. 2, Abt. 3, n. 4, 48 pp., 12 pl., Wien.

Barnard P. D. W., 1967 — *Flora of the Shemshak formation.* Pt. 2. *Liassic plants from Shemshak and Ashtar.* Riv. Ital. Paleont. Strat., vol. 73, pp. 539-588, 4 pl., Milano.

Barnard P. D. W., 1967 — *Two new plants from the Upper Triassic of North East Afghanistan.* Riv. Ital. Paleont. Strat., vol. 73, pp. 723-728, 2 pl., Milano.

Benda L., 1964 — *Die Jura-Flora aus der Saighan-Serie Nord-Afghanistans.* Beih. Geol. Jb., Bd. 70, pp. 99-152, 8 pl. Berlin.

Boureau E., Furon R. & Rosset L. F., 1950 — *Contribution à l'étude des flores jurassiques d'Asie.* Mém. Mus. Hist. Nat., N.S., t. 2, pp. 207-242, 8 pl., Paris.

Brongniart A., 1828 — *Prodrome d'une histoire des végétaux fossiles.* Vol. of VIII + 223 pp., Paris.

Bubnoff S., 1956 — *Einführung in die Erdgeschichte.* Vol. of XIV + 808 pp., 65 pl., Berlin.

Compter G., 1874 — *Ein Beitrag zur fossilen Keuperflora.* Nova acta, Bd. 37, n. 3, 10 pp., 2 pl., Dresden.

Compter G., 1894 — *Die fossile Flora des unteren Keupers von Ostthüringen.* Zeitschr. Naturwiss., Bd. 67, pp. 205-230, 2 pl., Leipzig.

Frentzen K., 1922 — *Die Keuperflora Badens.* Verh. Naturwiss. Ver. Karlsruhe, Bd. 28, pp. 1-76, 4 pl., Karlsruhe.

Harris T. M., 1932 — *The fossil flora of Scoresby Sound, East Greenland.* Pt. 3. *Caytoniales and Bennettitales.* Meddr. Gronland, Bd. 85, pp. 3-133, 19 pl., Kjobenhavn.

Heer O., 1853 — *Beschreibung der angeführten Pflanzen und Insekten.* (A. *Pflanzen*, pp. 115-132). In Escher A.: *Geologische Bemerkungen über das nördliche Vorarlberg und einige angrenzenden Gegenden.* Neue Denksch. Allg. Schweiz. Ges. Naturw., Bd. 13, n. 5, 136 pp., 10 pl., Zürich.

Heer O., 1865 — *Die Urwelt der Schweiz.* Vol. of XXX + 622 pp., 11 pl., Zürich.

Heer O., 1876-1877 — *Flora Fossils Helvetiae. Die Worweltliche Flora der Schweiz.* Zweite Lieferung. *Die Pflanzen der Trias und des Jura.* Vol. of VI + 82 pp., 70 pl., Zürich.

Jacob K. & Shukla B. N., 1955 — *Jurassic plants from the Saighan series of Northern Afghanistan and their palaeoclimatological and palaeogeographical significance.* Mem. Geol. Surv. India, Pal. Indica, N.S., vol. 33, n. 2, 64 pp., 13 pl., Calcutta & Delhi.

Jaeger G. F., 1827 — *Über die Pflanzenversteinerungen welche in dem Bausandstein von Stuttgart.* Vol. of 46 pp., 8 pl., Stuttgart.

Kräusel R., 1921 — *Über einige Pflanzen aus dem Keuper von Lunz.* Jahrb. Preuss. Geol. Landesanst., Bd. 41, pp. 192-209, 3 pl., Berlin.

Kräusel R., 1943 — *Die Ginkgophyten der Trias von Lunz in Nieder-Österreich und von Neue Welt bei Basel.* Palaeontographica B, Bd. 87, pp. 59-93, 15 pl., Stuttgart.

Leuthardt R., 1903-1904 — *Die Keuper Flora von Neuwelt bei Basel.* Abh. Schweiz. Paleont. Ges., Bd. 30, pp. 1-23, pl. 1-10; Bd. 31, pp. 25-48, pl. 11-21, Zürich.

Prynada V. D., 1934 — *Mesozoic Plants from Pamir.* Akad. Nauk USSR, Trudi. Ekspedi. Geol. Pamir 1932-3, n. 9, 100 pp., 11 pl., Leningrad. (Russian text, English summary).

Schoenlein J. L. & Schenk A., 1865 — *Abbildungen von Fossilen Pflanzen aus dem Keuper Frankens.* 22 pp., 13 pl., Weisbaden.

Schenk A., 1864 — *Beiträge zur Flora der Keupers und der rhaetischen Formation.* Sitz. Ber. Naturw. Ges. Bamberg 1862-64, pp. 51-142, 8 pl., Bamberg.

Schlotheim E. F., 1822 — *Nachträge zur Petrefactenkunde.* (Pt. 2, *Plants*). Vol. of VI + + 100 pp., 21 pl., Gotha.

Seward A. C., 1912 — *Mesozoic plants from Afghanistan and Afghan-Turkestan.* Mem. Geol. Surv. India, Pal. Indica, N.S., vol. 4, 57 pp., 7 pl., Calcutta.

Sitholey R. V., 1940 — *Jurassic plants from Afghan-Turkestan.* Mem. Geol. Surv. India, Pal. Indica, N.S., vol. 29, 25 pp., 7 pl., Calcutta & Delhi.

Sikstel T. A., 1960 — *Stratigraphy of the Upper Permian and Triassic continental deposits of Central Asia.* Trudy Inst. Geol. Akad. Nauk Tad. SSR, vol. 13, 147 pp., 19 pl., Tashkent. (Russian text).

Thomas H. H., 1930 — *Further Observations on the Cuticle Structure of Mesozoic Cycadean Fronds.* Journ. Linn. Soc. Lond., vol. 48 Bot., pp. 389-415, 2 pl., London.

Zeiller R., 1903 — *Flore fossile gîtes de charbon du Tonkin. Etude gîtes minéraux de la France.* Vol. of VIII + 328 pp., 56 pl., Paris.

JURASSIC FOSSILS

NEW CONTRIBUTION TO THE KNOWLEDGE OF THE JURASSIC FAUNA OF KARKAR (AFGHANISTAN)

by

CARLA ROSSI RONCHETTI

Director of the Institute of Paleontology of the University of Milan

Foreword

An initial illustration of the marine fauna of the Jurassic zone of Karkar was published by us in 1961 (C. Rossi Ronchetti and N. Fantini Sestini) and referred to paleontological material collected by L.F. Rosset, comprising Corals, Brachiopods and Lamellibranchs.

New collections were made also in the summer of 1961 in the same zone by A. Desio and G. Pasquarè, during the expedition to central Badakhshan carried out with E. Martina. This material was examined by the present writer and the results are presented here, with the aim of forming a new and more complete picture of the Jurassic macrofauna of Karkar.

Previous work

Earlier paleontological knowledge of the Karkar region has been referred to in the above-mentioned work, and only subsequent work will be reported on here.

Between 1961 and the present day the Karkar zone has reawakened the interest of various workers, in particular G. Gabert, who in 1964 subdivided the Jurassic marine series above the coal (Hangende Kohlenserie) into three parts:

a lower part (untere Hangende Kohlenserie) referred to the Bathonian-Callovian on the foraminiferal fauna studied by M. Kaever; a middle part (Characeen-Horizont) assigned to the Bathonian-Callovian on the basis of Charophytes and Ostracods, and an upper part (obere Hangende Kohlenserie) attributed to the Oxfordian-Kimmeridgian on the grounds of its Foraminifera.

In september 1965 there appeared the work of M. Kaever with the lists of microfossils identified in the three stratigraphical units given above, and which were useful in the dating given by Gabert.

Chronostratigraphical considerations were given in march of the same year by A. de Lapparent and J. de Lavigne on the Saighan series, observed at Saighan, Ishpushta, Dara-e-Souf and Karkar. In the Doud Kach locality, near Karkar, the authors collected from the top of the coal macrofossils which included a rostrum of a Belemnite and an Ammonite fragment, in addition to Lamellibranchs which S. Freneix identified as *Goniomya intersectans* Smith, *Homomya gibbosa* Sowerby, *Pleuromya calceiformis* Sowerby, cf. *Gresslya abducta* Phillips, *Protocardia* cf. *boonei* Cossmann, *Lima* cf. *complanata* Laube. According to the authors, all of the evidence tends to assign a rather high Bathonian age to the marine fauna of the top of the coal at Karkar.

In december 1965 A. Desio published, in conjunction with M.B. Cita and I. Premoli Silva, a stratigraphical-micropaleontological study of the Karkar Formation, which was described as found with the description and illustration of the type-section. The formation was concluded to be composed of a lower fossiliferous calcareous-arenaceous-clayey member dated to the Middle-Upper Jurassic on the evidence of microfossils, and an unfossiliferous upper clayey-marly member indirectly assigned to the Upper Jurassic.

Considerations on the macrofauna

The paleontological material comprising the subject of this report was mostly collected in situ in the type-section of Karkar partly by A. Desio (samples 61 AD-65/2, 61 AD-65/3), and partly by G. Pasquarè (samples 61 AP-178/6).

The samples denoted as 61 AP-178/6 are from level 5 of the type-section and comprise grey-brown marly limestone, sometimes laminated, with coquina of small Lamellibranchs, and also greenish-white laminated sandy clay. They have provided the following:

Gervillella sp.
* *Camptonectes* cf. *annulatus* (Sowerby)
Camptonectes sp. ind. cf. *C. laminatus* (Sowerby)

Camptonectes richei Dechaseaux
Placunopsis socialis Morris & Lycett
* *Plagiostoma cardiiforme* Sowerby
* *Pseudolimea duplicata* (Sowerby)
Protocardia sp.
Cossmannea (*Eunerinea*) *pasquarei* sp. n.
Colostracon (*Ovactaeonina*) *phasianoides* (Lycett)

About 10 m from the base an *Ostrea*-bearing lens is included in level 5 and it contains *Liostrea eduliformis* (Schlotheim).

The other fossils collected separated by A. Desio probably come from the same fossiliferous beds. The samples denoted as 61 AD-65/3 consist of brownish-grey limestones with intercalations of reddish and greenish marls and have provided the following species of Lamellibranchs:

* *Meleagrinella echinata* (W. Smith)
Oxytoma sp.
Ctenostreon rugosum (W. Smith)
* *Plagiostoma subcardiiforme* (Greppin)
* *Nanogyra nana* (Sowerby)
Pronoella desioi sp. n.
Pronoella kurkarensis sp. n.
Eomiodon gardeti Mongin
Corbula sp.
Homomya douvillei nom. n.
Pholadomya sp. aff. *deltoidea* (Sowerby)
* *Pholadomya hemicardia* Roemer
* *Pholadomya lirata* (Sowerby)

The samples denoted 61 AD-65/2, which were not collected in situ, consist of chestnut-coloured to yellowish bioclastic marly limestones and were found to faunally consist essentially of Rhynchonellids assignable to *Burmirhynchia hsenwiensis* Buckman.

25 forms of Brachiopods, Lamellibranchs and Gastropods have been recognised, the nomenclature of six of which has been left open on account of their poor state of preservation. Two species of Lamellibranchs and one of Gastropods have resulted from new institutions.

If this fauna is now compared with that identified in 1961 in the material of Rosset, it is seen that there are only 8 species in common and they are those indicated with an asterisk in the lists reported above. Thirteen species result therefore from new records for the Jurassic of Karkar.

The new research carried out in the area has also revealed the presence of a *Liostrea* horizon, previously unknown, and packed with specimens of *Liostrea eduliformis* (Schlotheim), and a horizon of small Lamellibranchs consisting largely of representatives of the genus *Pronoella* and to a lesser extent those of the genera *Eomiodon*, *Corbula*, *Meleagrinella* and *Oxytoma*.

A great abundance of Brachiopods of the genus *Burmirhynchia* was also found, belonging to a single species, and Gastropods of the genera *Nerinea* and *Colostracon* were recorded for the first time from this region.

In addition, other genera were recorded for the first time from this zone, i.e. *Gervillella*, *Placunopsis*, *Ctenostreon*, *Protocardia* and *Homomya*.

The complete absence of Corals of the genera *Chomatoseris* and *Montlivaltia* must be noted; these were represented by at least 11 species in the material of Rosset.

The above gives a more complete picture of the Jurassic marine fauna of Karkar, and in order to illustrate it better the full list of forms recognised by the authors is given below:

Corals

Chomatoseris porpites (W. Smith)
Montlivaltia cf. *caryophyllata* Lamouroux
Montlivaltia cornutiformis crassa Gregory
Montlivaltia cottreaui (Collignon)
Montlivaltia culullus Gregory
Montlivaltia cyclolitoides Milne Edwards & Haime
Montlivaltia decipiens (Goldfuss)
Montlivaltia gregoryi Alloiteau
Montlivaltia hourcqi Alloiteau
Montlivaltia numismalis (d'Orbigny)
Montlivaltia sp.

Brachiopods

Acanthothyris sp.
Burmirhynchia hsenwiensis Buckman
Sphenorhynchia sp. aff. *plicatella* (Sowerby)

Lamellibranchs

Gervillella sp.
Camptonectes annulatus (Sowerby)
Camptonectes sp. ind. cf. *C. laminatus* (Sowerby)
Camptonectes richei Dechaseaux
Camptonectes rigidus (Sowerby)
Camptonectes sp.
Oxytoma cf. *inaequivalve* (Sowerby)
Oxytoma sp.
Meleagrinella echinata (W. Smith)
Placunopsis socialis Morris & Lycett
Ctenostreon rugosum (W. Smith)
Plagiostoma cardiiforme Sowerby
Plagiostoma subcardiiforme (Greppin)
Pseudolimea duplicata (Sowerby)

Liostrea eduliformis (Schlotheim)
Nanogyra crassa (W. Smith)
Nanogyra nana (Sowerby)
Trigonia cf. *pullus* Sowerby
Lucina cf. *rotundata* (Roemer)
Protocardia sp. ind.
Pronoella desioi sp. n.
Pronoella karkarensis **sp. n.**
Eomiodon gardeti Mongin
Corbula sp. aff. *daghaniensis* Cox
Corbula sp.
Homomya douvillei nom. n.
Pholadomya sp. aff. *deltoidea* (Sowerby)
Pholadomya hemicardia Roemer
Pholadomya lirata (Sowerby)
Myopholas acuticosta (Sowerby)
Pleuromya uniformis (Sowerby)
Pleuromya sp. ind.

Gastropods

Cossmannea (*Eunerinea*) *pasquarei* sp. n.
Colostracon (*Ovactaeonina*) *phasianoides* (Lycett)

Chronostratigraphical considerations

The new discoveries do not alone appear to offer decisive evidence for the chronostratigraphical assignment of the Jurassic fauna of Karkar; at most they confirm previously held conclusions.

The fauna is now reviewed in its entirety in order to extract all evidence. Of 29 forms definitely identified as regards species (see table 1), 27 are present in the Bathonian, while only two appear subsequently in the Callovian.

Of the 27 species listed above, 10 have no chronostratigraphical significance owing to their wide distribution, five have been recorded both in the Bathonian and in the Callovian, while 12 do not extend above the Bathonian; of these the 11 following are limited to this horizon, and a few also to more recent horizons: *Montlivaltia cyclolitoides* Milne Edwards & Haime, *M. decipiens* (Goldfuss), *M. hourcqi* Alloiteau, *M. numismalis* (d'Orbigny), *Burmirhynchia hsenwiensis* Buckman, *Camptonectes annulatus* (Sowerby), *C. rigidus* (Sowerby), *Placunopsis socialis* Morris & Lycett, *Ctenostreon rugosum* (W. Smith), *Eomiodon gardeti* Mongin, *Colostracon* (*Ovactaeonina*) *phasianoides* (Lycett).

The species are mostly present both in the Bathonian and in the Callovian, confirming in general principle the dating given in 1961. The new discoveries increase the number of species limited to the Bathonian, however, and the number now comprises a rather substantial proportion of the entire fauna (about 38%). If it is noted that some of these appear in the Upper Bathonian or reach their greatest abundance there, it can be maintained that the horizon of origin of the fossils, and in particular level 5 of the type-section, are assignable to the most recent horizons of the Bathonian.

TABLE 1

	Bajocian	Bathonian	Callovian	Oxfordian
Corals				
Chomatoseris porpites (W. Smith)		—	—	
Montlivaltia cornutiformis crassa Gregory			—	
Montlivaltia cottreaui (Collignon)		—	—	
Montlivaltia culullus Gregory		—	—	
Montlivaltia cyclolitoides Milne Edwards & Haime		—		
Montlivaltia decipiens (Goldfuss)		—		
Montlivaltia gregoryi Alloiteau		—	—	
Montlivaltia hourcqi Alloiteau		—		
Montlivaltia numismalis (d'Orbigny)		—		
Brachiopods				
Burmirhynchia hsenwiensis Buckman		—		
Lamellibranchs				
Camptonectes annulatus (Sowerby)		—		
Camptonectes richei Dechaseaux	—	—		
Camptonectes rigidus (Sowerby)		—		
Meleagrinella echinata (W. Smith)	—	—	—	
Placunopsis socialis Morris & Lycett		—		
Ctenostreon rugosum (W. Smith)		—		
Plagiostoma cardiiforme Sowerby	—	—	—	
Plagiostoma subcardiiforme (Greppin)	—	—	—	
Pseudolimea duplicata (Sowerby)	—	—	—	—
Liostrea eduliformis (Schlotheim)	—	—	—	
Nanogyra crassa (W. Smith)	—	—	—	
Nanogyra nana (Sowerby)	—	—	—	—
Eomiodon gardeti Mongin		—		
Homomya douvillei nom. n.		—	—	
Pholadomya hemicardia Roemer			—	—
Pholadomya lirata (Sowerby)	—	—	—	—
Myopholas acuticosta (Sowerby)		—	—	—
Pleuromya uniformis (Sowerby)	—	—	—	—
Gastropods				
Colostracon (Ovactaeonina) phasianoides (Lycett)		—		

PALEONTOLOGICAL DESCRIPTIONS

BRACHIOPODA

Class Articulata

Order Rhynchonellida

Superfamily Rhynchonellacea Gray, 1848

Family Rhynchonellidae Gray, 1848

Subfamily Tertarhynchiinae Ager, 1965

Genus **Burmirhynchia** Buckman, 1918

Burmirhynchia hsenwiensis Buckman, 1918

Pl. 6, fig. 1-5; Pl. 7, fig. 1; text-fig. 1, 2

1918 *Burmirhynchia hsenwiensis* Buckman. *Namyau Beds*, p. 144, pl. II, fig. 1-4; pl. XV, fig. 28.

? 1918 *Burmirhynchia shanensis* Buckman. *Namyau Beds*, p. 143, pl. I, fig. 11-15.

? 1918 *Burmirhynchia hsipawensis* Buckman. *Namyau Beds*, p. 145, pl. II, fig. 5-8.

Material — About 70 specimens, of which about half are in a good state of preservation. The others are partially deformed and almost completely encrusted with spathic calcite.

External characters — Inflated shell, medium to large size, length and width approximately equal, outline rounded to subpentagonal, maximum length corresponding with commissure between fold and sulcus, maximum thickness between 1/2 and 2/3 of length, mesaured from beack. Pedicle valve thickness about 1/3 that of brachial valve. Valves united by strongly dentellated commissures, in relief, straight in correspondence with the lateral slopes, slightly lobate in correspondence with the front. Many specimens are asymmetrical, only slightly so for the most part, but some exhibit pronounced asymmetry in the tongue of the sulcus, which is not central and which is sharply bounded on one side, while the other disappears gradually. Thick shell.

Pedicle valve with strong beack, inflated, erect, not projecting beyond the plane of the commissure. Palintrope narrow and elongated, limited laterally by pronounced beack-ridges. Venter markedly inflated, and the thickest point of the valve; from here the valve declines in all directions. Sulcus poorly defined, convex at the base, distinguishable only beyond 3/4 of the rectified length meas-

(1) The « Treatise on Invertebrate Paleontology », of R. C. Moore (1965) is followed for the classification of the Brachiopods. For that of the Lamellibranchs the sistematic and bibliographic catalogue of the « Genera of the Bivalvia » is used, published under the direction of H. E. Vokes (1967). The work of W. Wenz (1938-44) and A. Zilch (1959-60) is followed for the Gastropods.

ured from the beack. Tongue with rounded shape, subtrapezoidal to broadly arcuate near the front, regularly curved in longitudinal section, and at the base having a breadth of about 65% of the total width.

Commissure between sulcus and fold from vertical to retroflex in adult specimens. Lateral slopes vertical in correspondence to the commissure only in the postero-lateral region.

Brachial valve with beack bent back beyond the vertical. Valve with rather rapid thickening in the first third of the rectified length, measured from the beack, then regularly developed in a curve for the remaining two thirds. Sulcus poorly defined, separated beyond 3/4 of the rectified length measured from the beack, convex in transversal section, decreasing towards the commissure in longitudinal section. Lateral slopes convex, vertical at the commissure. Ornament comprising simple costae, numerous and close together, starting from the beack, very well defined, triangular in section with rounded top. There are not great differences in size between the median costae and the first lateral costae, and because of the uncertain definition on the margins of the sulcus and of the fold, it is particularly difficult to distinguish both the possible presence of parietal costae, and also to determine the costae formula. Assuming parietal costae to be absent, the most representative ratios appear to be the following: 8-9/7-8; 0; 7-8/8-9.

The total number of costae per valve fluctuates around 24, with extreme limits of 20 and 28 respectively.

Variability — The species under examination appears on the whole to be homogeneous. Among the characters which vary the most are the definition of the sulcus and the relief of the fold, rather well pronounced in some specimens, and on the other hand transitional and distinguishable only with difficulty in others. The asymmetrical positions of the sulcus and the fold in some specimens are also to be noted. Finally, there are noteworthy variations in the thickness of the shell, but they are related to the ontogenetic development of the animal.

Growth — In the juvenile stage there are forms with a strong development of the pedicle beack, and therefore a strong development of the pedicle valve, which has an almost equal thickness to that of the brachial valve. The juvenile specimens have a rather flat shape, with sharp commissure, only weakly curved in the anterior part, brachial beack moderately inclined. The thickness increases during growth proportionally more than the other parameters and the brachial valve becomes increasingly inflated, particularly in the gerontic stages (width exceeding 30 mm).

Dimensions (in mm) ([1]) —

	L	W	Th	Lpv	Tpv	Tbv	ShA	L/W	Th/W	Th/L
A	20.35	19.70	11.90	29.00	5.60	6.30	68°	1.04	0.68	0.69
B	23.75	25.25	17.30	33.00	8.15	9.15	73°	0.94	0.68	0.73
C	23.55?	26.10	17.20	33.00	7.50	9.70	—	0.90?	0.66	0.73?
D	26.50	26.00	19.40	38.00	8.10	11.30	70°	1.02	0.75	0.73
E	26.65	27.30	20.45	39.00	7.15	13.30	68°	0.98	0.75	0.76
F	28.10	28.20	21.15	43.00	8.70	12.55	62°?	0.99	0.76	0.75

Internal characters ([2]) — Ventral muscle field very little in relief, with adductor muscles and diductors of indistinct outline and shape; the adjustors are more evident and are elliptical and divided by a short myophragm.

Delthyrium partially closed by two deltidial plates of medium dimensions, separated from but very close to the base of the delthyrium (see pl. 7, fig. 1 b).

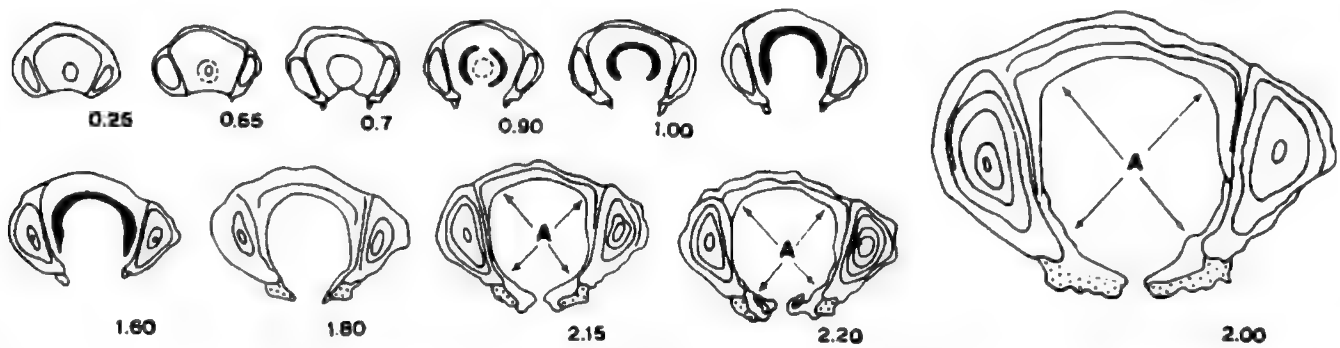


Fig. 1 - ***Burmirhynchia hsenwiensis*** **Buckman, 1918. Camera lucida drawings of serial transversal sections, × 3.5, details × 7 and × 10.5; distances are in mm forward from the crest of the umbo. Specimen G, Karkar. In the first seven sections the pedicle collar (blackened) is seen. Inside the pedicle collar the delthyrial cavity is effectively open, initially limited to the zone indicated, and then to the whole area enclosed by the pedicle collar. (Dots indicate deltidial plates, which in the initial sections appear reduced when viewed in profile; A = pedicle callist of delthyrial chamber).**

In transversal section the deltidial plates, like the rest of the apical cavity, are strongly thickened on account of the pedicle callist. Pedicle collar well developed, length about 1 mm. Foramen elliptic, almost in contact with the brachial beack. Delthyrial cavity broad internally, of trapezoidal shape; laterial cavities of medium size, partially closed by the pedicle callist. Dental plates straight and divergent at the intersection with the surface of the valve (i.e. divergent in the sense of Buckman) and also divergent in transversal section ([3]). Strong and straight, exhibiting a small characteristic internal keel in the upper part, and

(1) The symbols used for the dimensions have the following meaning: L = length; W = width; Th = thickness; Lpv = rectified length of the pedicle valve; Tpv = thickness of the pedicle valve; Tbv = thickness of the brachial valve; ShA = shoulder angle.

(2) In order to avoid repetition, the external characters of the delthyrium are also described here.

(3) This is if the dental plates are considered as viewed from a central point of the shell.

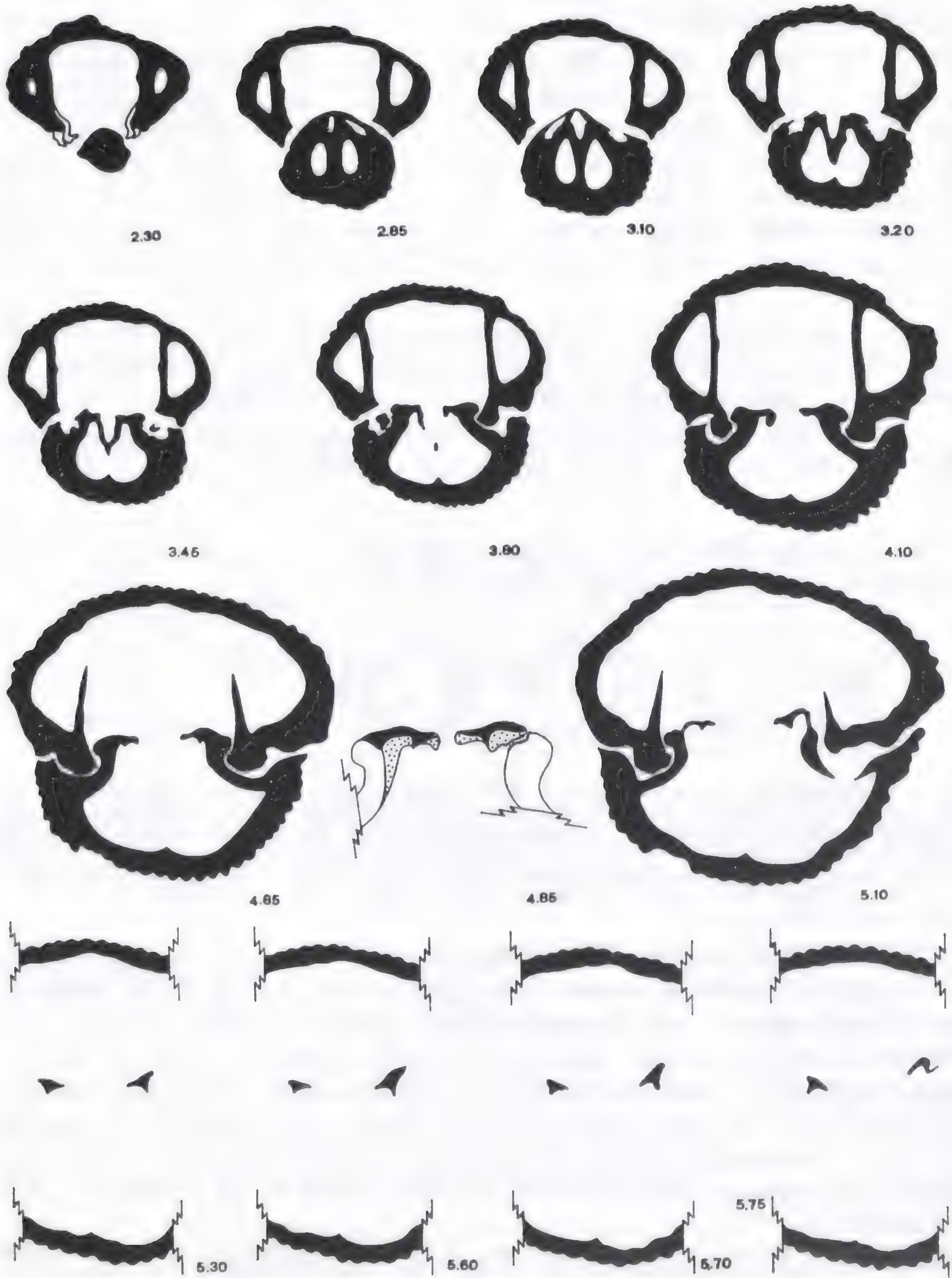


Fig. 2 - *Burmirhynchia hsenwiensis* Buckman, 1918. Camera lucida drawings of serial transversal sections, × 3.5; distances are in mm forward from the crest of the umbo. Specimen G, Karkar.

terminating with teeth of medium size, rounded externally, with articulated surfaces. The divergence of the dental plates diminishes in the anterior region and they tend to become subparallel.

Dorsal muscle field broad, not much elevated (pl. 7, fig. 1 a). The anterior cover of the adductor muscles has a piriform course, transitional anteriorly, and divides only in the posterior part of the median septum, which terminates at about half the course of the anterior adductor muscles. Posterior adductor muscles more pronounced, bean-shaped, without any sulcus dividing them from the anterior adductors. Diductors not well defined, with anterior margin frayed. Secondary diductors not distinguishable. Median septum short and stumpy, bearing the septalium for a short distance. Septalium very deep and V-shaped. Cardinal plates almost straight, strong, slightly inclined towards the centre. Inner socket ridges poorly defined. Dental sockets broad and deep, with crenulated surface posteriorly, usually with more than 5 crenulae for each cavity. There are not however correspondences between the crenulae of the dental sockets and the surfaces of the teeth, which appear to be rather smooth in transversal section. Crural bases spaced from one another, very near to the inner socket ridges. Crura rather small, and subtriangular in shape, directed towards the pedicle valve and laterally. The observation is imprecise on account of the rather extensive recrystallisation.

Discussion — It is not possible to say whether the internal characteristics described are those of the type species of the genus *Burmirhynchia*, *B. gutta*, or even those of the species of Burma attributed to this genus. The generic attribution is based therefore on the external characters and on the meagre evidence about the internal characters provided by Buckman (1918). The specimens under examination appear to belong to the series *B. hpalaiensis* of Buckman, and have been attributed to *B. hsenwiensis*; it is however noteworthy that various species of Buckman appear to be inconsistent, and the result of an excessive typological splitting. Several species, such as *B. shanensis* and *B. hsipawensis* could in fact be combined in a single species with *hsenwiensis*. Among the various specific names that of *hsenwiensis* has preference, because on the grounds of the specimens illustrated this name appears to characterise the bulk of the single species here conjectured.

Occurrence — The *Burmirhynchia* of the *hpalaiensis* series are from the Namyau beds, the attribution of which to the Upper Bathonian has also been confirmed by Arkell (1956, p. 414).

Locality — Detritus at the base of the Karkar section. 61 AD-65/2.

MOLLUSCA

Class Bivalvia

Order Pterioida

Suborder Pteriina

Superfamily Pteriacea Broderip, 1839

Family Bakevelliidae King, 1850

Genus **Gervillella** Waagen, 1907

Gervillella sp.

On a sample of grey-brown marly limestone is visible the internal surface of a left valve, incomplete posteriorly, partially encrusted with calcite, and specifically indeterminate.

Valve rather small, very inequilateral, ovate-oblique, narrow, moderately inflated, with ventral and dorsal margins subparallel. 4 ligament pits, slightly impressed and of variable width.

Locality — Karkar. 61 AP-178/6.

Superfamily Pectinacea Rafinesque, 1815

Family Pectinidae Rafinesque, 1815

Subfamily Pseudamussiinae Vokes, 1967

Genus **Camptonectes** Meek, 1864

Camptonectes cf. **annulatus** (Sowerby, 1826)

A single valve, very incomplete and with a rather worn surface, preserved in grey-brown marly limestone. Could be close to the species of Sowerby (1845, p. 559, pl. 542, fig. 1), despite the uncertainty due to the state of preservation.

Orbicular-oval in shape, with height of about 42 mm, ornamented with upright concentric growth lamellae, prominent and as far as can be ascertained close together. In the interlaminar spaces very fine radial striae are clearly visible, and are sometimes bifurcate.

Remarks — The specimen attributed by us to this species in 1961 (Rossi Ronchetti and Fantini Sestini, p. 121, pl. XIII, fig. 10) is larger than that under examination, has a more orbicular shape, more elevated concentric growth lamellae, and broader interlaminar spaces.

Locality — Karkar. 61 AP-178/6.

Camptonectes sp. ind. cf. **C. laminatus** (Sowerby, 1818)

A fragment of Pectinid valve in a grey-brown marly limestone, definitely referable to the genus *Camptonectes* by its characteristic ornament, consisting of fine, slightly sinuous punctate striae, radiating fanwise and sometimes bifurcate.

The state of preservation does not permit a certain specific determination; some resemblance is however seen to *Camptonectes laminatus* (Sowerby) and in particular to the specimen identified by Morris and Lycett (1863) as *Pecten lens* Sowerby (p. 10, pl. II, fig. 1, 1 a), an identification which Arkell (1930, p. 96) corrected as *C. laminatus* (Sowerby).

Locality — Karkar. 61 AP-178/6.

Camptonectes richei Dechaseaux, 1936

Pl. 9, fig. 10

1936 *Camptonectes richei* Dechaseaux. *Pectinidés jurass.*, p. 32, pl. IV, fig. 12, 13, 15; pl. V, fig. 1, 2.

A left valve incompletely preserved, with a partly worn surface, appears referable to a species instituted by Dechaseaux, and shows some considerable resemblance to fig. 15 of pl. IV in particular.

Valve ovoidal in shape, slightly more high than long, almost flat, with broad anterior auricle, clearly separated from the body of the valve, posterior auricle not preserved, beack small and pointed, apical angle about 88°. Ornament comprising very fine dense growth lamellae, which appear to extend over the whole of the surface.

Dimensions — Length mm 26.5 (?)
Height mm 28.4

Occurrence — Bajocian of the Lorena and Mont-d'Or Lyonnais. Bathonian of Lorena.

Locality — Karkar. 61 AP-178/6.

Famly OXYTOMIDAE Ichikawa, 1958

Genus **Meleagrinella** Whitfield, 1885

Meleagrinella echinata (W. Smith, 1817)

Pl. 9, fig. 12

1817 *Avicula echinata* W. Smith. *Stratigr. system organ. fossils*, p. 67.
1961 *Meleagrinella echinata* Rossi Ronchetti and Fantini Sestini. *Fauna giurass. Karkar*, p. 120, pl. X, fig. 11, 12 (*cum syn.*).
1965 *Meleagrinella echinata* Cox. *Jurass. Bivalvia and Gastrop. Tanganyika Kenya*, p. 48.
1969 *Meleagrinella echinata* Fischer. *Bathon. Massif Ardennais*, p. 86.

Three left valves in a grey-brown coquina, more or less well preserved, of medium to small dimensions, with almost the same height and length; convexity and obliquity more or less pronounced. Ornament comprising distinct principal radial ribs, irregularly distributed, and intercalated more or less developed costellae.

Dimensions — Length mm 12.2; 16; 18.7
Height mm 11.9; 16; 19.3

Occurrence — Bajocian-Callovian, with maximum frequency in the Upper Bathonian.

Locality — Karkar mine. 61 AD-65/3.

Family Placunidae Gray, 1840

Genus **Placunopsis** Morris & Lycett, 1853

Placunopsis socialis Morris & Lycett, 1853

1853 *Placunopsis socialis* Morris and Lycett. *Great Oolite*, p. 7, pl. I, fig. 11, 11 a.
1907 *Placunopsis socialis* Cossmann. *Bath. St. Gaultier*, p. 238, pl. VIII, fig. 11, 12.
1948 *Placunopsis socialis* Cox and Arkell. *Surv. Brit. Great Oolite*, p. 16.
1964 *Placunopsis socialis* Fischer. *Faune bathon. Indre*, p. 20.
1969 *Placunopsis socialis* Fischer. *Bathon. Massif Ardennais*, p. 91.

A single left valve in grey-brown marly limestone, of very small size, imperfectly preserved as an internal mould with traces of the shell. Shape orbicular-oval, rather convex, with pointed umbo projecting slightly beyond the hinge line, margins rounded, ornament not preserved.

Dimensions — Length mm 3.7
Height mm 4.5

Occurrence — Abundantly distributed throughout the English Bathonian and in the Middle Bathonian of Saint Gaultier (Indre).

Locality — Karkar. 61 AP-178/6.

Superfamily Limacea Rafinesque, 1815

Family Limidae Rafinesque, 1815

Genus **Plagiostoma** Sowerby, 1814

Plagiostoma cardiiforme Sowerby, 1815

1961 *Lima (Plagiostoma) cardiiformis* Rossi Ronchetti and Fantini Sestini. *Fauna giurass. Karkar*, p. 125, pl. XIII, fig. 11 (*cum syn.*).

A single left valve of medium dimensions, in grey-brown marly limestone, rather well preserved except in the apical region and reproducing the diagnostic characteristics of the species of Sowerby.

Oblique shape, rather convex, with height and length almost the same; anterior margin long and oblique and posterior one arcuate; surface covered by about sixty radial grooves, slightly undulate and rather regular, densely punctate in the central portion of the valve, where the shell is better preserved, separated by flat spaces, smooth, breadth about twice that of the grooves, which are in relief in the form of ribs near the ventral margin.

Dimensions — Length mm 25 (?)
Height mm 25

Remarks — The left valve under examination has dimensions twice as large as those of the right valve identified by us at Karkar in 1961 as *Lima (Plagiostoma) cardiiformis* (Sowerby). All of the other characters correspond however.

The new denomination of the species results from the fact that Hayami (1959, p. 64) has elevated the subgenus *Plagiostoma* to the rank of a genus. Since the word « stoma » is of neutral gender in Greek, the ending of the specific name has to be correspondingly altered.

Occurrence — Distributed from the Bajocian to the Callovian and has so far been recorded in England, France, Switzerland, Afghanistan and India.

Locality — Karkar. 61 AP-178/6.

Plagiostoma subcardiiforme (Greppin, 1870)

1961 *Lima (Plagiostoma) subcardiiformis* Rossi Ronchetti and Fantini Sestini. *Fauna giurass. Karkar*, p. 125, pl. X, fig. 13 (*cum syn.*).
1964 *Lima (Plagiostoma) subcardiiformis* Fischer. *Faune bathon. Indre*, p. 21.
1967 *Lima (Plagiostoma) subcardiiformis* Mongin. *Moll. Bathon. saumâtre*, p. 48.
1969 *Lima (Plagiostoma) subcardiiformis* Fischer. *Bathon. Massif Ardennais*, p. 92, pl. X, fig. 3.

One left valve, two right valves and a very incomplete bivalve specimen, contained in grey-brown marly limestone and in faded yellow limestone; variable dimensions; all rather poorly preserved, but nevertheless permit identification as the species named by Greppin in 1870 and agree substantially also with the specimen identified by us in 1961.

Occurrence — Bajocian-Callovian, broadly distributed in England, France, Switzerland, Montenegro, Morocco and Kenya. Also recorded at Karkar (Afghanistan).

Locality — Karkar mine. 61 AD-65/3.

Genus **Pseudolimea** Douglas & Arkell, 1932

Pseudolimea duplicata (Sowerby, 1827)

1956 *Pseudolimea duplicata* Agrawal. *Jurass.Kutch*, p. 84, pl. IX, fig. 15, 16.
1961 *Pseudolimea duplicata* Rossi Ronchetti and Fantini Sestini. *Fauna giurass. Karkar*, p. 127, pl. X, fig. 14 (*cum syn.*).
1964 *Pseudolimea duplicata* Fischer. *Faune bathon. Indre*, p. 23.
1965 *Pseudolimea duplicata* Cox. *Jurass. Bivalvia and Gastrop. Tanganyika Kenya*, p. 64, pl. 8, fig. 8 a-b.
1969 *Pseudolimea duplicata* Fischer. *Bathon. Massif Ardennais*, p. 93.

One left valve only, of very small dimensions, not perfectly preserved, but agreeing well with the species of Sowerby in shape and in general proportions, in the number of the radial ribs (twenty), and in their V-shaped cross-section.

Compared with the bivalve specimen determined by us in 1961 the present valve is substantially smaller and consequently more resembles the specimen from Tanganyika illustrated by Cox (1965).

Occurrence — Species of broad distribution, being recorded from the Upper Lias to the Upper Kimmeridgian, and also of broad geographical distribution.

Locality — Karkar. 61 AP-178/6.

Genus **Ctenostreon** Eichwald, 1862

Ctenostreon rugosum (W. Smith, 1817)

Pl. 9, fig. 9

1817 *Ostrea rugosa* W. Smith. *Stratigr. system organ. fossils*, pp. 92, 106.
1853 *Lima luciensis* Morris and Lycett. *Great Oolite*, p. 28, pl. III, fig. 4.
1853 *Lima pectiniformis* Morris and Lycett. *Ibidem*, p. 26, pl. VI, fig. 9.
1863 *Lima rudis* Lycett. *Supplement Monogr.*, p. 123.
1900 *Lima (Ctenostreon) luciensis* Cossmann. *Seconde note Bath. St. Gaultier*, p. 54, pl. VI, fig. 5.
1930 *Ctenostreon rugosum* Cox. *Brit. Foss. named W. Smith*, p. 302.
1932 *Ctenostreon rugosum* Arkell. *Corall. Lamell.*, p. 146.
1948 *Ctenostreon rugosum* Cox and Arkell. *Surv. Moll. Brit. Great Oolite*, p. 18.
1952 *Ctenostreon rugosum* Cox. *Jurass. Lamell. Cutch*, p. 65.
1964 *Ctenostreon rugosum* Fischer. *Faune bathon. Indre*, p. 23.
1969 *Ctenostreon rugosum* Fischer. *Bathon. Massif Ardennais*, p. 94.

One external mould of the right valve, of medium dimensions, contained in grey-brown marly limestone and not perfectly preserved. Valve slightly convex, prosocline, with posterior side rounded, umbo slightly projecting forward; auricles not preserved; surface ornamented with 8-9 radial ribs, strong, rounded, broader than the intervals separating them. Growth lamellae seen only on the anterior side, and become elevated on the radial ribs, rendering them rugose.

Dimensions — Length mm 32 (?)
Height mm 37 (?)

Occurrence — Recorded throughout the Bathonian of England, in the Lower Bathonian of Indre and in the Upper Bathonian of Luc (Calvados).

Locality — Karkar mine. 61 AD-65/3.

Suborder OSTREINA

Superfamily OSTREACEA Rafinesque, 1815

Family OSTREIDAE Rafinesque, 1815

Genus **Liostrea** Douvillé, 1904

Liostrea eduliformis (Schlotheim, 1820)

Pl. 7, fig. 2-4; Pl. 8, fig. 1-4

1820 *Ostrea eduliformis* Schlotheim. *Petrefaktenkunde*, p. 233.
1833 *Ostrea eduliformis* von Zieten. *Versteinerungen Wurttembergs*, p. 63, pl. XLV, fig. 1 a-d.
1834 *Ostrea explanata* Goldfuss. *Petrefacta Germaniae*, II, p. 22, pl. LXXX, fig. 5.
1888 *Ostrea eduliformis* var. *trigona* Schlippe. *Bathon. Oberrhein. Tieflande*, p. 110, pl. I, fig. 1, 2.
1917 *Ostrea eduliformis* Rollier. *Foss. nouv. ou peu connus*, p. 58.
1917 *Ostrea trigona* Rollier. *Ibidem*, p. 581.
1923 *Ostrea explanata* Lissajous. *Bathon. environs Macon*, p. 136, pl. XXVII, fig. 1, 2, 3; pl. XXVIII, fig. 1.
1929 *Ostrea eduliformis* Schäfle. *Lias und Doggeraustern*, p. 56, pl. V, fig. 9, 10; pl. VI, fig. 1 (*cum syn.*).
1952 *Liostrea eduliformis* Cox. *Jurass. Lamell. Cutch*, p. 72 (only discussion).

Six left valves and three right valves, more or less preserved, with the shell in a grey-brown coquinoid limestone; of the six left valves three are attached by the interior surface of the valve; the other three are free but are not complete in the marginal regions. Of the three right valves only one is almost complete and isolated; another is isolated but very fragmentary, while the third is visible only from the internal side, since the external surface adheres to the rock.

The shell, which is more or less thickened, is very foliated, attains a fairly large size, and in complete specimens is trigonally ovate or sickle-shaped, being produced postero-ventrally. In specimens incomplete at the marginal regions the shape is more ovoidal, but elongated in terms of height or length according to the condition of preservation.

The left valve, when seen over the whole of its surface, is almost flat, with a slightly pointed umbo, not prominent, incurved behind. Surface ornamented by foliated growth lamellae, irregularly undulate, more pronounced at irregular intervals, but rather widely spaced. In certain places radial striae are intercalated. The interior of the valve is evenly hollowed-out and the margins are flat; only the posterior margin rises rather steeply to jut out somewhat as a ridge in the medio-dorsal region. The muscle scar, which is rather large, suborbicular, fairly impressed and sometimes divided, lies rather posteriorly at about 2/5 of the height in the ventral region. A groove of broadly ovoidal shape encircles the muscle scar at a distance; it corresponds to the pallial line and is deeper and more evident on the anterior side and beneath the muscle scar. The ligament area is broad at the base, moderately elongated and flattened, with the central depression wide and parallel-sided; the lateral areas are of feeble convexity and in fact almost flat and are crossed by rather well pronounced transversal lamellae.

Right valve flat, trigonally ovate in shape, more or less extended posteriorly, with small acute umbo incurved backwards; anterior margin very arcuate, passing imperceptibly into the ventral margin as a regular curve; posterior margin concave, with gentle sinuosity corresponding to the postero-ventral expansion. Surface ornament of slender growth lamellae, foliated and concentric, rather widely spaced, and of fine radial striae, more evident in the medio-umbonal region. The interior of the valve is slightly hollowed-out, with flat margins in the ventral half of the valve; in the dorsal half the anterior and posterior margins become elevated and appear in relief; the muscle scar is rather large, suborbicular and not impressed; it lies posteriorly at about 2/5 of the height in the ventral region. The ligament area is flattened, broad at its base, with undulate margins; the central depression is less wide than on the left valve and the lateral areas are flat. The pallial line appears less evident than on the other valve.

Dimensions —

		L	H
r.v.	mm	79;	82
r.v.	mm	54;	58
r.v.	mm	80 (?);	86
l.v.	mm	69;	78

Occurrence — According to Cox (1952) the species ranges in Europe from the Inferior Oolite to the *macrocephalus* Beds.

Locality — Karkar. 61 AP-178/6.

Genus **Nanogyra** Beurlen, 1958

Nanogyra nana (Sowerby, 1822)

1957 *Exogyra nana* Khimshiashvili. *Upper Jurass. Georgia*, p. 139, pl. XXI, fig. 7-10.
1961 *Exogyra nana* Rossi Ronchetti and Fantini Sestini. *Fauna giurass. Karkar*, p. 128, pl. XIII, fig. 3, 7-9.
1964 *Exogyra nana* Wellnhofer. *Pelecyp. Neuburger Bankkalke*, p. 52, pl. 3, fig. 8-11; text-fig. 30.
1965 *Exogyra nana* Cox. *Jurass. Bivalvia and Gastrop. Tanganyika Kenya*, p. 73, pl. 11, fig. 5, 6 a-b.
1965 *Nanogyra nana* Freneix. *Biv. Jurass. Tunisien*, p. 41, pl. V, fig. 2-6.
1969 *Nanogyra nana* Fischer. *Bathon. Massif Ardennais*, p. 96.

A few small left and right valves, somewhat polymorphic. They correspond well with the species of Sowerby, which has been identified by the present authors in Afghanistan.

Occurrence — Species of broad geographical and stratigraphical distribution, being recorded (according to Freneix, 1965) from the Bajocian to the Portlandian in Europe, Africa and Asia.

Locality — Karkar mine. 61 AD-65/3.

Subclass Heterodonta

Order Veneroida

Suborder Astartedontina

Superfamily Cardiiacea Lamarck, 1809

Family Cardiidae Lamarck, 1809

Genus **Protocardia** Beyrich, 1845

Protocardia sp. ind.

An incomplete impression of a right valve, referable to the genus *Protocardia*, and to which is attached the imprint of the posterior side of the left valve. The radial costae are clear and defined, and number about 20 on the posterior side of the valve, the shape of which forms a very obtuse angle with the shell body. The specific identification is not possible owing to the incompletely preserved character of the fossil.

Locality — Karkar. 61 AP-178/6.

Suborder VENERINA

Superfamily ARCTICACEA Newton, 1891

Family ARCTICIDAE Newton, 1891

Genus **Pronoella** Fischer, 1887

Pronoella desioi sp. n.

Pl. 9, fig. 4-8

Material — The holotype and a dozen paratypes isolated from a greyish-brown coquina consisting largely of representatives of the genus *Pronoella*; among them are nine left valves and three right valves (61 AD-65/3).

Holotype — A left valve, A 1505, pl. 9, fig. 4.

Locus typicus — Karkar mine (Afghanistan).

Stratum typicum — Karkar Formation, lower member. Upper Bathonian.

Derivatio nominis — The specific name *desioi* is proposed in honour of the collector, Prof. Ardito Desio.

Location — Paleontology Institute of Milan University. Register number A 1505.

Diagnosis — Small sized *Pronoella*, subequilateral, slightly more long than high, triangular, carinated posteriorly, with robust umbo, high and protruding on the hinge line; ventral margin straight.

Description — Holotype (A 1505): an internal mould of the left valve with part of the original shell; small size, subtriangular in outline, with height/length ratio = 91%; moderately inflated. Umbonal region broad and prominent, rather sharply rounded; umbo robust, recurved with prosogyre beak situated at about half the length, slightly inclined anteriorly. Postero-dorsal margin rather long and straight, steeply inclined, forming an angle of 80° with the antero-dorsal margin, meeting the short posterior margin in an obtuse angle (120°) at about half the height. Ventral margin of feeble convexity anteriorly, then straight, forming a well-marked obtuse angle with the posterior margin (125°). Anterior margin of rather weak convexity, anterior extremity just below mid-height, antero-dorsal outline feebly excavated. Lunule poorly defined, escutcheon long, narrow, well impressed, limited by a sharp ridge. A well-defined carina runs with a slightly sigmoidal curve from the umbo to the postero-ventral corner of the shell, delimiting a fairly wide flattened posterior area. Surface with fine concentric threads, more well defined at irregular intervals. Internal characters unknown.

Dimensions —

			L	H
Holotype	(r.v.)	mm	11.4;	10.4
Paratype n. 6	(r.v.)	mm	7.9;	6.7

Paratype n. 3	(l.v.)	mm	12.4;	12.1
Paratype n. 2	(r.v.)	mm	11.5;	9.4

Paratypes — The paratypes under examination, both the isolated ones and those still contained in the coquina, have variable dimensions, but are always small, being of length between 7.9 mm and 12.4 mm. They exhibit a marked uniformity in morphological characteristics; the equivalve shell is always carinate posteriorly and the carina is more or less pronounced. The umbo is always very prominent and robust and the apical angle is constant. The proportions between height and length vary somewhat (between 81% and 97%), but the two parameters are always rather close together. The ventral margin of the internal moulds is finely costate, and this appears to be the result of dense striation which in some cases is in evidence on the internal layer of the shell.

Remarks — The species is referred to *Pronoella* only on account of the external characters and because of some resemblance to some species of this genus, as *Pronoella beneckei* Rollier (= *P. lebruniana* Benecke, 1905, p. 240, pl. XIX, fig. 3, 4, not d'Orbigny). This has however larger dimensions, is more inequilateral, and has an umbo situated more anteriorly as a consequence of which the posterior carina becomes longer and less inclined; also the postero-dorsal margin is less inclined with relation to the horizontal, from which there results a larger value both for the apical angle (90°) and for the angle of conjunction with the posterior margin (150°), which is in its turn less near vertical. The escutcheon-carina is less definite and the escutcheon is less impressed.

Pronoella karkarensis sp. n. is differentiated by its different proportions (height/length ratio between 69% and 75%, instead of between 81% and 97% as in the species under examination), by the shape, which is trigonally ovate and not subtriangular, by its umbonal region which is narrower and less robust with a less high umbo which is also less incurved and pointed, and by the greater apical angle (110° instead of 80°). In addition, the postero-dorsal margin is less inclined and meets the posterior one above its mid-height, the ventral margin is longer and more straight, and the posterior carina is more obtuse. These differences tend to separate the two forms.

Pronoella curvirostris Cox, 1947 from the English Aalenian (p. 177, pl. 10, fig. 84, text-fig. 52 a-b) which has rather similar proportions (height/length ratio 84%), differs in having a more arcuate umbo which is situated more anteriorly; a shorter and feebly convex postero-dorsal margin, gently sloping, which joins with the posterior one imperceptibly; a strongly convex ventral margin which is not straight; a more strongly excavated antero-dorsal outline; a deeper lunule, and in the absence of the escutcheon.

From the description given it is proposed to institute a new species for these forms of *Pronoella*, which are the most frequent in the coquina of small Lamellibranchs indicated above.

Pronoella karkarensis sp. n.

Pl. 9, fig. 1-3

Material — The holotype and the five paratypes isolated from a greyish-brown coquina consisting predominantly of representatives of the genus *Pronoella*; of these two are left valves and four are right valves (61 AD-65/3).

Holotype — A 1506, a left valve, pl. 9, fig. 1.

Locus typicus — Karkar mine (Afghanistan).

Stratum typicum — Karkar Formation, lower member. Upper Bathonian.

Derivatio nominis — The species is named after Karkar.

Location — Paleontology Institute of Milan University. Register number A 1506.

Diagnosis — *Pronoella*, small sized, subequilateral, more long than high, trigonally ovate, with high pointed umbo, not very robust, ventral margin straight.

Description — Holotype A 1506: internal mould of left valve with part of the original shell, small size, trigonally ovate, rather more long than high (height/length ratio 73%), moderately inflated. Umbonal region not very broad, and acute. Umbo pointed, slightly recurved and scarcely prosogyre, placed at about mid-length. Postero-dorsal margin straight, gently sloping, forming an angle of 110° with the antero-dorsal margin, meeting the posterior margin above the mid-height in an obtuse angle (137°). Ventral margin straight, forming an obtuse angle with the posterior margin (about 100°). Anterior margin broadly convex, anterior extremity at about mid-height, antero-dorsal outline feebly excavated. Lunule narrow but well impressed, escutcheon narrow, limited by a ridge. A rounded off, obtuse ridge runs from the umbo to the postero-ventral corner. Surface with several fine concentric threads, more pronounced at irregular intervals. Internal characters unknown.

Dimensions —

			L	H
Holotype	(l.v.)	mm	8.2;	6.0
Paratype n. 5	(r.v.)	mm	10.8;	7.5
Paratype n. 8	(l.v.)	mm	20.0;	15.0

Paratypes — Of the paratypes, four are small and more or less complete; the fifth is an internal mould of greater dimensions, but which is nevertheless attributable to this new species. It has not been selected as the holotype on account of its incompleteness.

Remarks — This species is ıeferred to *Pronoella* on account of the external characters and because of its general resemblance to other species of this genus, such as *Pronoella lotharingica* Benecke, *P. putealis* Cox and *P. desioi* sp. n.

Pronoella lotharingica Benecke, 1905 (p. 236, p. XVIII, fig. 4-8) of the Aalenian of Lorena is distinguished however by being more inequilateral, and having a larger apical angle (120° instead of 110°), a more inclined and longer postero-dorsal margin, a higher and more rounded anterior side, and a different course of the ventral margin.

Pronoella putealis Cox, 1965 (p. 109, pl. 17, fig. 10, 11) of the Bajocian (?) of Tanganyika is more cuneiform and more beaked posteriorly, with the posterior extremity much below the mid-height and the postero-dorsal margin, concave and long, whereas the ventral one is convex; furthermore the apical angle is greater (120°) and the lunule and the escutcheon are not defined.

Pronoella desioi sp. n. has different proportions, a more triangular shape, a more robust and arcuate umbonal region, with a higher and more incurved umbo, a lesser apical angle, a longer and more oblique postero-dorsal margin, and a posterior carina which is more pronounced.

From this it is proposed to institute a new species of the genus *Pronoella*.

Family NEOMIODONTIDAE Casey, 1955

Genus **Eomiodon** Cox, 1935

Eomiodon gardeti Mongin, 1967

Pl. 9, fig. 11

1967 *Eomiodon gardeti* Mongin. *Moll. Bathon. saumâtre,* p. 55, pl. 3, fig. 6-9, 11-16, 19-25 (*cum syn.*).

Two left valves of very small size partially included in a greyish-brown coquina, exhibiting the characteristics of the species instituted by Mongin in 1967 for the Morocco (Moyen Atlas). Shell inequilateral, transversally ovate, rather flattened, with a small pointed umbo; ornament comprising small sharp projecting growth lamellae, somewhat spaced in the ventral region.

Occurrence — This species occurs in the Bathonian of Morocco, Tripolitania and Madagascar.

Locality — Karkar mine. 61 AD-65/3.

Subclass Anomalodesmata

Order Pholadomyoida

Suborder Pholadomyina

Superfamily Pholadomyacea Gray, 1847

Family Pholadomyidae Gray, 1847

Genus **Homomya** Agassiz, 1843

Homomya douvillei nom. n.

Pl. 10, fig. 2; Pl. 11, fig. 6

1916 *Pholadomya inornata* Douvillé. *Massif du Moghara,* p. 55, pl. IV, fig. 5.
1925 *Pholadomya (Homomya) gibbosa* Sow. var. *asiatica* Cox. *Bajoc.-Bathon. Jordan Valley,* p. 178, pl. XIV, fig. 8 a-b.
1935 *Pholadomya (Homomya) inornata* Cox. *Jurass. Gastrop. Lamell. Brit. Somaliland,* p. 192, pl. XXI, fig. 6, 7 (not fig. 5).
1960 *Pholadomya inornata* Joubert. *Geol. Mandera-Damassa area,* pl. XI, fig. 7.
1968 *Homomya inornata* Ficcarelli. *Foss. Giuresi Nilo Azzurro,* p. 41, pl. 4, fig. 2, 2 a-b.

Two internal bivalve moulds, of rather large dimensions, rather well preserved in grey-brown marly limestone. The best preserved specimen is oblong-ovate, with height about 2/3 of the length, and maximum convexity in the umbonal region (thickness/length ratio = 56%), with umbones situated at about 1/3 of the length. In front of the umbones, the profile of the shell shows only a very slight dorsal concavity, then the anterior margin broadens in a regular curve of broad radius which continues in the ventral margin. The latter is arcuate and in the postero-ventral part curves more rapidly upwards, becoming subparallel to the postero-dorsal margin and the posterior end of the shell is obliquely subtruncated; posterior gape narrow. Posterior umbonal ridge bordering a rather broad escutcheon. Ornaments consisting of concentric folds, more evident on the ventral side. There is no furrow descending ventrally from the umbo.

The second specimen, longer and slightly deformed, has height equal to about 1/2 of the length, while the thickness/length ratio is 51%. It is more elongate posteriorly and tapers very slightly in this direction, so that its end is somewhat pointed.

Dimensions —

		I	II
Length	mm	70.0;	77.6
Height	mm	47.5;	43.0
Thickness	mm	39.4;	40.0

Remarks — The previous authors cast some doubt in the attribution of the form of Moghara to *Pholadomya ? inornata* Sowerby made by Douvillé in 1916. In his latest work, published in 1965, Cox has recorded the presence of the species of Sowerby (p. 127) in the Callovian of Kenya. In the synonymy of the species there is no trace either of the form from Sinai, indicated by Douvillé, or of that of the Jordan Valley and British Somaliland recorded also by Cox in 1925 and 1935. The form of Mandera-Damassa illustrated by Joubert (1960) is also not recorded.

The forms are in effect ones which agree among themselves in morphological characters, but which differ from the species of Sowerby, as has already been emphasized. For this reason the afro-asian forms recorded above are united in a single species, to which the new name *douvillei* is ascribed in honour of Douvillé who first recognised it. The form of the Southern Blue Nile considered by Ficcarelli (1968) can be united with it, on the basis of Douvillé's illustrations.

Occurrence — So far recorded in the Bathonian-Callovian of Sinai, in the Middle Jurassic of the Jordan Valley, in the Callovian of British Somaliland and of the Mandera-Damassa (Kenya), in the Callovian of the Southern Blue Nile.

Locality — Karkar mine. 61 AD-65/3.

Genus **Pholadomya** Sowerby, 1823

Pholadomya sp. aff. **deltoidea** (Sowerby, 1818)

Pl. 10, fig. 1

One internal bivalve mould, of large dimensions, ovately globose, very gaping posteriorly, with the height slightly in excess of the length (height/length ratio = 90%); anterior side slightly produced, with antero-dorsal margin combining with the anterior one in a regular curve which continues in the ventral margin, incomplete posteriorly. Postero-dorsal margin very short; the contact with the posterior is missing. Umbones elevated and gibbous, directed inwards and slightly forwards, anterior but not terminal. Ornament consisting of seven main ribs, of which one is very slight on the anterior side, the other six on the medio-posterior side; of these the first five are equally spaced and developed, but the sixth is hardly perceptible. The ribs attenuate before disappearing on the ventral side; the posterior side is smooth. Umbonal region crossed by elevated concentric growth ridges (five in one centimetre), which cross the radial ribs, forming at the point of intersection slight nodosities elongated transversally. The remainder of the surface of the valve is crossed by growth lamellae which are more irregular and more pronounced on the ventral side.

Dimensions — Length	mm	81
Height	mm	78
Thickness	mm	61

Remarks — The most closely comparable species described appears to be *Pholadomya deltoidea* (Sowerby) (= *Ph. solitaria* Morris and Lycett, 1855 p. 124, pl. XI, fig. 1; pl. XII, fig. 2; = *Ph. deltoidea* Lycett, 1863, p. 86, pl. XLII, fig. 4, 4 a), the commonest species, according to Cox and Arkell (1948) in the Cornbrash and frequent also throughout the Great Oolite. This species is however more elongate posteriorly and more truncated anteriorly, has more pronounced radial ribs (particularly the second from the anterior margin), which extend as far as the ventral margin, while the concentric ornament is appreciably less well developed. No other species of *Pholadomya* exhibits closer affinity; since however only one specimen is available, it is not proposed to institute a new taxon; the specimen is considered merely to belong to a species related to *Ph. deltoidea* (Sowerby).

Locality — Karkar mine. 61 AD-65/3.

Pholadomya hermicardia Roemer, 1835

1956 *Pholadomya hemicardia* Agrawal. *Jurass. Kutch*, p. 125.
1957 *Pholadomya hemicardia* Khimshiashvili. *Upper Jurass. Georgia*, p. 160, pl. XX, fig. 2.
1961 *Pholadomya hemicardia* Rossi Ronchetti and Fantini Sestini. *Fauna giurass. Karkar*, p. 135, pl. XII, fig. 4-6 (*cum syn.*).
1965 *Pholadomya hemicardia* Alencaster de Cserna and Buitron. *Fauna Jurass. sup. Petlalcingo*, p. 34, pl. 9, fig. 5.
1965 *Pholadomya hemicardia* Cox. *Jurass. Bivalvia and Gastrop. Tanganyika Kenya*, p. 127, pl. 20, fig. 5.

An internal bivalve mould, showing all the morphological characteristics of the species above, recorded by the authors from Karkar.

Occurrence — Distributed from the Callovian to the Kimmeridgian in England, Switzerland, Deutschland, Russia, Kenya and Tanganyika, India, Mexico. It has already been recorded at Karkar.

Locality — Karkar mine. 61 AD-65/3.

Pholadomya lirata (Sowerby, 1818)

1956 *Pholadomya lirata* Agrawal. *Jurass. Kutch*, p. 125, pl. XI, fig. 9 a-c.
1960 *Pholadomya lirata* Joubert. *Geology Mandera-Damassa area*, pl. 11, fig. 6.

1961 *Pholadomya* cf. *lirata* Rossi Ronchetti and Fantini Sestini. *Fauna giurass. Karkar*, p. 135, pl. XII, fig. 7-9 (*cum syn.*).
1964 *Pholadomya lirata* Fischer. *Faune bathon. Indre*, p. 31.
1965 *Pholadomya lirata* Cox. *Jurass. Bivalvia and Gastrop. Tanganyika Kenya*, p. 126, pl. 20, fig. 8 (*cum syn.*).
1967 *Pholadomya lirata* Mongin. *Moll. Bathon. saumâtre*, p. 65, pl. 4, fig. 21.
1969 *Pholadomya lirata* Fischer. *Bathon. Massif Ardennais*, p. 118, text-fig. 27, 28.

An internal bivalve mould, rather deformed and not very well preserved, in grey-brown marly limestone is referable with a certain degree of uncertainty to the species of Sowerby widely discussed by the preceding authors and tentatively identified by the present authors at Karkar.

Occurrence — Distributed from the Bajocian to the Callovian of England and also in the Middle and Upper Bathonian of Indre (France), in the Upper Bathonian of Morocco, in the Callovian of Kenya, in the Bajocian and Callovian of Tanganyika, in the Callovian of British Somaliland, in the Callovian-Oxfordian of Kutch (India). It as already been recorded at Karkar.

Locality — Karkar mine. 61 AD-65/3.

GASTROPODA

Subclass PROSOBRANCHIA

Order MESOGASTROPODA

Superfamily NERINEACEA Wenz, 1940

Family NERINEIDAE Zittel, 1873

Genus **Cossmannea** Pčelincev, 1931

Subgenus **Eunerinea** Cox, 1949

Cossmannea (Eunerinea) pasquarei sp. n.

Pl. 11, fig. 2-5

Material — The holotype and a dozen paratypes in more or less fragmentary condition, of medium dimensions, with height varying from 43 mm to 79 mm, fossilised in a grey-brown marly limestone.

Holotype — A 1507, pl. 11, fig. 4.

Locus typicus — Karkar (Afghanistan).

Stratum typicum — Karkar Formation, lower member. Upper Bathonian.

Derivatio nominis — The specific name *pasquarei* is proposed in honour of the collector, Prof. Giorgio Pasquarè.

Location — Paleontology Institute of Milan University. Register number No. A 1507.

Description — Holotype of medium to small dimensions, incomplete at the apex and at the base. Shape subcylindrical, turriculate, with spire angle of 11°, multispiral, with more than five whorls growing slowly and uniformly in height and in diameter, more high than broad with height/diameter ratio = 80%. Whorls concave in the abapical third, with very prominent bulging sutural region, encircled at mid-height by rather oblique linear sutures. Aperture unknown.

The axial section of the paratype no. 1 exhibits a strong and rather broad columella and three internal folds: a palatal, a columellar and a parietal. The palatal fold is the most prominent, is rounded and is situated corresponding to the concavity of the whorls. Columellar fold abapical, acute and slightly projecting; parietal fold slender and inconspicuous, hooked towards the apex. Internal cavity of whorls comprising a small rounded adapical part, a broad median expansion between the parietal folds and the columellar ones, and a broad and low abapical portion.

Dimensions —

		Holotype		Paratype n. 1
Height	mm	45.5 (?)	;	32.8
Diameter	mm	13.8	;	13.7
Spire angle		11°	;	14°

Remarks — The most closely comparable described species appears to be *Cossmannea* (*Eunerinea*) *eudesii* (Morris & Lycett, 1850) (in Arkell, 1931, p. 615, pl. L, fig. 1-6), common in the Great Oolite of England. It differs from the Afghan species however in its less cylindrical shape with greater spire angle (15°-18°), by the lower whorls with height equal to half the diameter, and by the columellar fold situated in a submedian position, so that is situated on the projection of the palatal fold; this latter is less broad and prominent, while the parietal fold is not hooked towards the apex, but is inclined abapically.

Another species somewhat resembling the Afghan form externally is *Cossmannea* (*Eunerinea*) *bathonica* Rigaux & Sauvage of the Bathonian (in Cossmann, 1885, p. 184, pl. II, fig. 1, 2; pl. XVIII, fig. 7-9). However, it appears to have greater dimensions, a more conical shape, lower whorls with height equal to 2/3 of the diameter, and only two internal folds: a palatal and median columellar one.

From the above, the proposition of a new species appears justified.

Subclass Euthyneura

Order Cephalaspidea

Superfamily Acteonacea d'Orbigny, 1842

Family Acteonidae d'Orbigny, 1842

Genus **Colostracon** Hamlin, 1884

Subgenus **Ovactaeonina** Cossmann, 1895

Colostracon (Ovactaeonina) phasianoides (Lycett, 1863)

Pl. 11, fig. 1

1851 *Actaeonina ? parvula* Morris and Lycett. *Mon. Moll. Great Oolite*, pt. I, p. 104, pl. V, fig. 12, 12 a (not 11, 11 a).
1863 *Actaeon bathonicum* Lycett. *Supplem. Great Oolite*, p. 25, pl. XLIV, fig. 16.
1863 *Actaeon phasianoides* Lycett. *Ibidem*, p. 26, pl. XLIV, fig. 28.
1950 *Acteonina (Ovactaeonina) phasianoides* Cox and Arkell. *Surv. Moll. Brit. Great Oolite*, pt. II, p. 88.

One specimen, of very small dimensions, may be referred to the species instituted by Lycett.

Shell small, ovately conical, spire turreted and consisting of 5 whorls, convex adapically in a short sutural ramp, flattened on their sides; sutures well defined. Last whorl ovoid, equal to slightly less than 60% of the total height, with short sutural ramp, becoming thinner towards the base and provided with short sutural ramp, becoming thinner towards the base and provided with a short straight canal. The aperture is elliptical and elongate; the columella is straight.

Remarks — The subgenus *Ovactaeonina*, to which Cox and Arkell, 1950, attribute the species of Lycett, has been placed by Zilch (1959) in the genus *Colostracon* Hamlin, 1884 and not in the genus *Acteonina* d'Orbigny, 1850, where it was placed by previous authors.

Occurrence — So far recorded only in the Bathonian of England (Great Oolite, Kemble Beds, Bradford Beds).

Locality — Karkar. 61 AP-178/6.

References

Agrawal S. K., 1956 — *Contribution à l'étude stratigraphique et paléontologique du Jurassique du Kutch (Inde)*. Ann. Centre Et. Document. Paléont., n. 19, 188 pp., 12 pl., 15 fig., Paris.

Alencaster de Cserna G., Buitron B. E., 1965 — *Fauna del Jurásico Superior de la región de Petlalcingo, Estado de Puebla.* Paleont. Mexicana, n. 21, 53 pp., 14 pl., Mexico.

Arkell W. J., 1929-37 — *A Monograph of British Corallian Lamellibranchia.* Palaeont. Soc., 1929-37, 392 pp., 56 pl., London.

Arkell W. J., 1931 — *The Upper Great Oolite, Bradford Beds and Forest Marble of South Oxfordshire, and the succession of Gastropods faunas in the Great Oolite.* Quart. Journ. Geol. Soc. London, vol. LXXXVII, pt. 4, n. 348, pp. 563-629, pl. XLVII-LI, 4 fig., London.

Arkell W. J., 1956 — *Jurassic Geology of the World.* Vol. of 806 pp., 46 pl., 102 fig., Ed. Oliver and Boyd Ltd., Edinburgh.

Benecke E. W., 1905 — *Die Versteinerungen der Eisenerzformation von Deutsch-Lothringen und Luxemburg.* Abhandl. Geol. Specialk. Elsass-Lothringen, N.F., Bd. 6, pp. 1-598, pl. 1-59, Strassburg.

Buckman S. S., 1917 — *The Brachiopoda of the Namyau Beds, Northern Shan States, Burma.* Palaeont. Indica, N.S., vol. III, Mem. 2, 254 pp., 21 pl., Calcutta.

Cossmann M., 1885 — *III Contribution à l'étude de la faune de l'étage Bathonien en France (Gastropodes).* Mém. Soc. Géol. France, ser. 3, vol. III, 374 pp., 28 pl., Paris.

Cossmann M., 1900 — *Seconde note sur les Mollusques du Bathonien de Saint-Gaultier (Indre).* Bull. Soc. Géol. France, ser. 3, t. XXVIII, pp. 165-201, pl. V-VIII, 13 fig., Paris.

Cossmann M., 1907 — *Troisième note sur le Bathonien de Saint-Gaultier (Indre).* Bull. Soc. Géol. France, ser. 4, t. VII, pp. 225-253, pl. VII-VIII, 4 fig., Paris.

Cox L. R., 1930 — *On British Fossils named by William Smith.* Ann. Mag. Nat. Hist., ser. 10, vol. VI, pp. 287-304, pl. XII, London.

Cox L. R., 1925 — *A Bajocian-Bathonian Outcrop in the Jordan Valley, and its Molluscan Remains.* Ann. Mag. Nat. Hist., ser. 9, vol. XV, pp. 169-181, pl. XIV, London.

Cox L. R., 1935 — *The Mesozoic Palaeontology of British Somaliland.* VIII. *Jurassic Gastropoda and Lamellibranchia.* Geol. Palaeont. Brit. Somaliland, pt. II, pp. 148-197, pl. XIV-XXI, Cardiff.

Cox L. R., 1947 — *The Lamellibranch Family Cyprinidae in the Lower Oolites of England.* Proc. Malac. Soc. London, vol. 27, pt. 4, pp. 141-184, pl. 8-10, 56 fig., London.

Cox L. R., 1952 — *The Jurassic Lamellibranch Fauna of Cutch (Kachh).* N. 3, *Families Pectinidae, Amusiidae, Plicatulidae, Limidae, Ostreidae and Trigoniidae.* (Supplement). Palaeont. Indica, ser. IX, vol. III, pt. 4, 128 pp., 12 pl., Calcutta.

Cox L. R., 1965 — *Jurassic Bivalvia and Gastropoda from Tanganyika and Kenya.* Bull. Brit. Mus. (Nat. Hist.), Geol., Suppl. 1, 213 pp., 30 pl., 2 fig., London.

Cox L. R., Arkell W. J., 1948, 1950 — *A Survey of the Mollusca of the British Great Oolite Series. Primarily a nomenclatorial revision of the Monographs by Morris and Lycett* (1851-55), *Lycett* (1863) *and Blake* (1905-1907). Palaeont. Soc., 1948, pp. I-XIII, 1-48; 1950, pp. XV-XXIII, 49-105, London.

Dechaseaux C., 1936 — *Pectinidés jurassiques de l'est du Bassin de Paris. Révision et biogéographie.* Ann. Paléont., t. XXV, 148 pp., pl. I-X, 14 fig., Paris.

Desio A., 1960 — *Ricognizioni geologiche nell'Afghanistan.* Boll. Soc. Geol. Ital., vol. LXXIX, fasc. 3, pp. 99-179, 18 fig., Roma.

Desio A., Cita M. B., Premoli Silva I., 1965 — *The Jurassic Karkar Formation in North-East Afghanistan.* Riv. Ital. Paleont. Strat., vol. 71, n. 4, pp. 1181-1222, pl. 102-109, 5 fig., Milano.

DESIO A., MARTINA E., PASQUARÈ G., 1964 — *On the Geology of central Badakhshan.* Quart. Journ. Geol. Soc. London, vol. 120, pp. 127-151, London.

DOUVILLÉ H., 1916 — *Les terrains secondaires dans le Massif du Moghara à l'est de l'Isthme de Suez. Paléontologie.* Mém. Ac. Sc. Inst. France, ser. 2, t. 54, pp. 1-184, 21 pl., 50 fig., Paris.

FICCARELLI G., 1968 — *Fossili giuresi della serie sedimentaria del Nilo Azzurro meridionale.* Riv. Ital. Paleont. Strat., vol. 74, n. 1, pp. 23-50, pl. 1-5, 3 fig., Milano.

FISCHER J.-C., 1957 — *La collection de Mollusques Jurassiques d'Edouard Piette.* Journ. Conchyl., vol. XCII, pp. 33-38, Paris.

FISCHER J.-C., 1964 — *Contribution à l'étude de la faune bathonienne dans la Vallée de la Creuse (Indre). Brachiopodes et Mollusques.* Ann. Paléont., t. L, fasc. 1, pp. 19-101, pl. I-II, 36 fig., 4 tab., Paris.

FISCHER J.-C., 1969 — *Géologie, paléontologie et paléoécologie du Bathonien au sud-ouest du Massif Ardennais.* Mém. Mus. Hist. Nat., N.S., ser. C, t. XX, 319 pp., 22 pl., 73 fig., 9 tab., Paris.

FRENEIX S., 1965 — *Les Bivalves du Jurassique moyen et supérieur du Sahara Tunisien (Arcacea, Pteriacea, Pectinacea, Ostreacea, Mytilacea).* Ann. Paléont., (Invert.), t. LI, fasc. 1, pp. 49-113, pl. I-V, 10 fig., Paris.

GABERT G., 1964 — *Zur Geologie des Gebietes von Karkar (Nordost-Afghanistan).* Beih. Geol. Jahrb., H. 70, pp. 77-98, 4 pl., 2 fig., Hannover.

GOLDFUSS G. A., 1826-44 — *Petrefacta Germaniae.* Vol. I (1826-33); vol. II (1833-40); vol. III (1844), Duesseldorf.

GREPPIN J. B., 1870 — *Description géologique du Jura bernois et de quelques districts adjacents.* Mat. Carte Géol. Suisse, Livr. 8, 357 pp., 7 pl., Berne.

HAYAMI I., 1959 — *Lower Liassic Lamellibranch fauna of the Higashinagano Formation in West Japan.* Journ. Fac. Sc. Univ. Tokyo, sec. II, vol. XII, pt. I, pp. 31-84, pl. V-VIII, Tokyo.

JOUBERT P., 1960 — *Geology of the Mandera-Damassa area.* Rep. Geol. Surv. Kenya, vol. 48, pp. 1-65, pl. 1-12, Nairobi.

KAEVER M., 1965 — *Mikropaläontologische Untersuchungen zur Stratigraphie Afghanistans.* Erdöl und Kohle-Erdgas-Petrochemie, Jahrg. 18, n. 9, pp. 678-684, 1 pl., 2 fig., Hamburg.

KHIMSHIASHVILI N. G., 1957 — *Fauna of the Upper Jurassic of Georgia (Cephalopoda and Lamellibranchiata).* Ac. Sc. R.S.S. Georgiana, sect. Paleont., 1967, 313 pp., 31 pl., Tbilisi.

LAPPARENT A. F. DE, LAVIGNE J. DE, 1965 — *A propos de l'âge de la série de Saïghan et du charbon en Afghanistan.* Ann. Soc. Géol. Nord., t. LXXXV, pp. 105-109, pl. VII, 3 fig., Lille.

LISSAJOUS M., 1923 — *Etudes sur la faune du Bathonien des environs de Macon.* Trav. Lab. Géol. Fac. Sc. Lyon, fasc. IV, Mem. 3, pp. 113-286, pl. XXV-XXXIII, 2 fig., Lyon.

LYCETT J., 1863 — *Supplementary Monograph on the Mollusca from the Stonesfield Slate, Great Oolite, Forest Marble and Cornbrash.* Palaeont. Soc., 1863, pp. 1-129, pl. XXXI-XLV, London.

MONGIN D., 1967 — *Les Mollusques du Bathonien saumâtre du Moyen Atlas.* Notes et Mém. Serv. Géol. Maroc, n. 200, pp. 35-95, 5 pl., Rabat.

MOORE R. C., 1965 — *Treatise on Invertebrate Paleontology.* Pt. H. *Brachiopoda.* 2 vol., 997 pp., 746 fig., Geol. Soc. America and Univ. Kansas Press, Lawrence, Kansas.

MORRIS J., LYCETT J., 1850, 1853, 1855 — *A Monograph of the Mollusca from the Great*

Oolite, chiefly from Minchinhampton and the Coast of Yorkshire. Palaeont. Soc., pt. I: *Univalves,* pp. I-VIII, 1-130, pl. I-XV; pt. II: *Bivalves,* pp. 1-80, pl. I-VIII; pt. III: *Bivalves,* pp. 81-147, pl. IX-XV, London.

Rossi Ronchetti C., Fantini Sestini N., 1961 — *La fauna giurassica di Karkar (Afghanistan).* Riv. Ital. Paleont.Strat., vol. LXVII, n. 2, pp. 103-152, pl. VIII-XIII, Milano.

Rollier L., 1911-20 — *Fossiles nouveaux ou peu connus des terrains secondaires (mésozoïques) du Jura et des contrées environnantes.* Vol. I, II. Mém. Soc. Paléont. Suisse, vol. XXXVII-XLIV, Genève.

Schäfle L., 1929 — *Über Lias- und Doggeraustern.* Geol. Palaeont. Abhandl., N.F., Bd. 17, H. 2, pp. 63-150, pl. IX-XIV, 12 fig., Jena.

Schlippe A. O., 1888 — *Die Fauna des Bathonien im Oberrheinischen Tieflande.* Abhandl. Geol. Specialk. Elsass-Lothringen, Bd. IV, H. IV, 266 pp., 8 pl., Strassburg.

Schlotheim E. F., 1820 — *Die Petrefactenkunde auf ihrem jetzigen Standpunkte durch die Beschreibung einer Sammlung versteinerter und fossile Überreste der Tier- und Pflanzenreichs des Worwelt erläutert.* Vol. I, LXII + 378 pp., Gotha.

Smith W., 1817 — *Stratigraphical system of organized fossils.* Vol. of 113 pp., London.

Sowerby J., 1845 — *Conchyologie minéralogique de la Grande Bretagne.* Vol. of 682 pp., 609 pl., Jent and Gassman Libr.-Ed., Soleure.

Vokes H. E., 1967 — *Genera of the Bivalvia: a systematic and bibliographic Catalogue.* Bull. Amer. Paleont., vol. 51, n. 232, pp. 103-394, Ithaca, New York.

Wellnhofer P., 1964 — *Zur Pelecypodenfauna der Neuburger Bankkalke (Mittel-Tithon).* Bayer. Ak. Wiss., Math.-Naturwiss. Kl., Abhandl., N.F., H. 119, pp. 7-143, pl. 1-7, 69 fig., München.

Wenz W., 1938-44 — *Gastropoda.* Teil I: *Allgemeiner Teil und Prosobranchia.* Handb. Palaeozool., Bd. 6, T. 1, 1639 pp., 4211 fig., Gebrüder Bornträger, Berlin.

Zieten H. von, 1830-33 — *Die Versteinerungen Württembergs.* Vol. of 102 pp., 72 pl., Stuttgart.

Zilch A., 1959-60 — *Gastropoda.* Teil 2: *Euthyneura.* Handb. Palaeozool., Bd. 6, T. 2, Lief. 1 (1959), pp. 1-200; Lief. 2 (1959), pp. 201-400; Lief. 3 (1960), pp. 401-600; Lief. 4 (1960), pp. 601-835; 2115 fig., Gebrüder Bornträger, Berlin.

CRETACEOUS AND PALEOGENE FOSSILS

UPPER CRETACEOUS MOLLUSCS AND BRACHIOPODS FROM BADAKHSHAN

by

ADELE BERIZZI QUARTO DI PALO

Assistant at the Institute of Paleontology of the Milan University

Introduction

The paleontological material forming the subject of the present report was collected in North-Eastern Afghanistan in 1961 during a scientific expedition sponsored by the C.N.R. and carried out by Prof. Ardito Desio, past Director of Geology Institute of Milan University, in collaboration with Dr. Ercole Martina and Dr. Giorgio Pasquaré.

The fauna examined comprises mostly Pelecypods, a few Gastropods and Brachiopods, and one Cefalopod, indicative of the presence of the Upper Cretaceous (Cenomanian-Senonian) in the Badakhshan region, from which the fossil material originates. The fossils are deposited at Paleontology Institute of Milan University [1].

Previous work

Macropaleontological studies are almost non-existent on the Cretaceous of North-Eastern Afghanistan, and in particular on the zones of Baba Darves, Qara Bulaq, Mohammad Aba, Farkhar, Darra Sarkhao and Doshi. One report largely of a geological nature exists, that of Desio, Martina and Pasquaré (1964) which

(1) The writer is grateful to Prof. Carla Rossi Ronchetti, Director of Paleontology Institute of Milan University, for advice given during the course of the studies, and for the critical supervision of this manuscript. Appreciation is also expressed to Dr. Andrea Allasinaz, who has followed the course of this work.

followed a preliminary note by Desio on Afghanistan (1960). Papers relating to the Cretaceous paleontology of other parts of Afghanistan are equally rare. A note by Bion and Coggin Brown (1925) lists, without illustrations, 17 forms, collected by Griesback, Hayden and Blanford, in Afghan Turkestan, in the Saighan district, and in the Punjab. The species quoted, which range from the Vectian (Lower Greensand) to the Campanian, are: *Cyphsoma* sp., *Micraster praecursor* Rowe, *Serpula* cf. *gordialis* Schlotheim, *S. filiformis* Sowerby, *Terebratula sella* Sowerby, *T. obesa* Sowerby, *T. biblicata* Sowerby, *Inoceramus balticus* Böhm, *Gryphaea vesicularis* Lamarck, *Exogyra decussata* Coquand, *E. plicifera* Dujardin, *E. ostracina* Lamarck, *Pecten* (*Neithea*) *quinquecostata* Sowerby, *Spondylus calcaratus* (?) Forbes, *Lima obliquestriata* Forbes, *Pholadomya* cf. *gigantea* Sowerby, *Cardium* sp.

From the surroundings of Herat the following Rudistes were illustrated by H. Douvillé in 1926 and attributed to the Upper Vraconian-Cenomanian: *Eoradiolites lyratus* Conrad, *Agria* sp., *Apricardia noetlingi* Blanckenhorn, *Sphaerulites griesbachi* Douvillé.

From the zone between Saighan and Bamian, situated slightly to the west and south of that considered by the present author, come the following species identified by Yabe (1959), distributed according to the author from the Albian to the Senonian: *Neithea quinquecostata* (Sowerby), *Inoceramus* aff. *balticus* Böhm, *Pterotrigonia* sp., *Pecten* sp., *Lopha* sp., *Limidae* and *Cardiidae* gen. and sp. ind.

In 1961 Rossi Ronchetti described several forms of Molluscs and Echinoids collected by Desio in stratigraphical succession at Pull-i-Khumri, a locality situated north of the Hindu Kush, in Kataghan. The species identified, which suggest the presence both of the Cenomanian and Turonian, are the following: *Terebratulina* cf. *relicta* Stoliczka, *Pseudocucullaea* cf. *lens* Solger, *Modiolus* cf. *typicus* (Forbes), *Inoceramus labiatus* (Schlotheim), *I. labiatus latus* Sowerby, *Plicatula fourneli* Coquand, *Liostrea acutirostris* (Nilsson), *L. rouvillei* (Coquand), *Pycnodonta vesicularis* (Lamarck), *Exogyra columba* (Lamarck), *E. conica* (Sowerby), *Afrodina plana* (Sowerby), *Turritella* cf. *nodosa* Roemer, *Epiaster* cf. *henrici* Peron & Gauthier, *Hemiaster* sp. ind.

In the same year Bobkova (1961) presented in a paper on Central Asia a synthesis of the Cretaceous forms encountered in Afghanistan; of these the following range from the Cenomanian to the Maastrichtian: *Liostrea acutirostris* (Nilsson), *L. rouvillei* (Coquand), *L. gautieri* (Thomas & Peron), *Gryphaea vesiculosa turkestanica* Bobkova, *G. vesicularis* (Lamarck), *G. vesicularis similis* Pusch, *Fatina* (*Avia*) *costei* (Coquand), *Lopha dichotoma* (Bayle), *L.* (*Arctostrea*) *falcata* (Morton), *L.* (*Arctostrea*) *mesenterica* (Morton), *L.* (*Arcostrea*) *tadjikistanica* Bobkova, *Exogyra turkestanensis* (Borneman), *Amphidonta columba* (Lamarck), *A.*

columba chaperi (Bayle), *Inoceramus labiatus* (Schlotheim), *I. labiatus latus* Sowerby, *Chlamys sokolovae* Bobkova, *Neithea quinquecostata* (Sowerby), *Gyropleura gaurdakensis* (Rengarten), *Praeradiolites kugitangensis* Bobkova.

In addition to the above-mentioned reports, there are a few ones of a geological-stratigraphical nature accompanied by stratigraphical plans, summary tables and fossil lists, e.g. that of Popol and Tromp (1954) relating to the Cretaceous of Afghanistan and a note of Menessier (1962) on the Cretaceous of Afghan Turkestan. In addition to this there is a study by Kaever (1963) on the Cretaceous-Tertiary section of Adjar and its position in the Upper Cretaceous of Central Asia, a paper of Hinze (1964) on the geological development of the Afghan northeastern flank of the Hindu Kush and a publication of de Lapparent and De Lavigne Sainte Suzanne (1964) on the sea Cretaceous of Saighan, and west of Hindu Kush. At last recently (1968) Kaever has published a critical revision of works on Afghan Cretaceous, which contains, in addition to the above mentioned publication, quite a number of works, but of slight paleontological importance.

A description of the Cretaceous fossils from Tajik Depression, which tectonically includes Northern Afghanistan, was given by Bobkova in the already-mentioned work on Central Asia in 1961. In the report the Author recorded more forms, of which the following have an appreciable occurrence between the Cenomanian and the Maastrichtian: *Ostrea tecticosta turkmenica* Borneman, *Liostrea acutirostris* (Nilsson), *L. prima* (Romanowskiy), *L. michailowskii* Borneman, *L. jaxartensis* (Simakov), *L. rouvillei* (Coquand), *L. delettrei* (Coquand), *Gryphaea vesiculosa turkestanica* Bobkova, *G. vesicularis* (Lamarck), *Fatina* (*Avia*) *costei* (Coquand), *F.* (*Avia*) *kugitangensis* (Borneman) emend. Bobkova, *F.* (*Avia*) *akkaptschigensis* Bobkova, *Lopha* (*Lopha*) *dichotoma* (Bayle), *L.* (*Arctostrea*) *falcata* (Morton), *Exogyra turkestanensis* (Borneman), *Ceratostreon spinosum* (Matheron), *Amphidonta columba* (Lamarck), *A. columba chaperi* (Bayle), *Gyropleura gaurdakensis* (Rengarten), *G. vakhschensis darwaseana* Bobkova, *Biradiolites boldjuanensis* Bobkova.

Composition of the fauna

The paleontological material studied comprises a total of about 200 specimens, of medium size and mostly not well preserved. Molluscs of the class *Bivalvia* are numerically predominant (80%); the remainder consists of Brachiopods (14%), Gastropods (5%) and Cephalopods.

35 species have been identified: 28 Pelecypods, 3 Brachiopods, 3 Gastropods and 1 Cephalopod.

The Lamellibranchs are listed in the systematic order proposed by Vokes

(1967), the Gastropods in that of Wenz (revised 1960-62), and the Brachiopods in that of Moore (1965). As regards generic classifications, specific studies of various authors have been consulted.

Trigonarca diceras (Seguenza)
Trigonarca sp. ind.
Pinna arata Forbes
Inoceramus sp. ind.
Neithea gibbosa (Pulteney)
Neithea (*Neitheops*) *quinquecostata* (Sowerby)
Pecten sp. ind.
Lima canalifera Goldfuss
Lima sp. ind.
Lima (*Acesta*) cf. *obsoleta* Dujardin
Amphidonte columba (Lamarck)
Amphidonte conica (Sowerby)
Amphidonte decussata (Goldfuss)
Ceratostreon spinosum (Matheron)
Exogyra overwegi von Buch
Exogyra sp. ind.
Lopha sp. ind.
Pycnodonte vesicularis (Lamarck)
Pycnodonte vesiculosa (Sowerby)
Trigonia sp. ind.
Sauvagesia sanfilippoi Parona
Ichthyosarcolites triangularis Desmarest
Ichthyosarcolites tricarinatus Parona
Cardita nicaisei Coquand
Arctica calabra (Seguenza)
Arctica sp. ind.
Veniella sp. ind.
Aphrodina plana (Sowerby)
Pleurotomaria sp. ind.
Haustator multiplicatus Pcelincev
Trochactaeon matensis (Fittipaldi)
Thomasites sp. ind.
Rectithyris odiumensis Sahni
Rectithyris cf. *rotunda* Sahni
Rectithyris subdepressa (Stoliczka)

The 35 forms determined are grouped into 23 genera and 16 families, 11 of which are of Lamellibranchs, 3 of Gastropods, one of Cephalopods and one of Brachiopods. The family with the greatest number of genera is indubitably the *Ostreidae* with 5 genera, followed by the *Pectinidae*, *Radiolitidae* and *Arcticidae* with two each; the other families are present with one genus each.

The genera best represented as regards number of species are: *Lima*, *Amphidonte*, *Rectithyris* with three forms each, followed by the genera *Neithea*, *Trigonarca*, *Pycnodonte*, *Exogyra*, *Ichthyosarcolites*, *Arctica* with two; all of the others consist of a single species.

The species most frequent as regards number of individuals is *Pycnodonte vesicularis* (Lamarck) with about 50 specimens, followed by *Pycnodonte vesiculosa* (Sowerby) with 30, *Ceratostreon spinosum* (Matheron) with 10, *Rectithyris subdepressa* (Stoliczka) with 8.

From the above, the faunal association under review appears to be characterised by a superabundance of *Ostreidae*, not only as regards numbers of species but also as regards individuals; among these the representatives of the genus *Pycnodonte* are the most abundant and widespread.

Critical examination of the fossiliferous localities

The fossils under consideration come from Northern Afghanistan, in the zone between Farkhar Valley and Doshi. The fossiliferous localities are considered here from the stratigraphical point of view in geographical order from west to east and from north to south.

Farkhar Valley (fossiliferous locality not indicated in the geological map) (61 AE-15) — In a locality of the Farkhar Valley, at about 4 km west of the road junction for Farkhar in the Baba Darves Formation (1), Echinoids have been collected together with:

Pycnodonte vesicularis (Lamarck) occurring from the Albian to the Upper Senonian.

Road junction to Farkhar (fossiliferous locality N. 4 of the geological map) (61 AE-87/11, 61 AE-87/13) — From a locality situated above the spur dominating, to the north, the road junction to Farkhar on the Taluqan-Faydzabad road, at an altitude of 1400 m, in the brown marly limestone of the Baba Darves Formation, the sample 61 AE-87/11 was collected, containing:

Amphidonte columba (Lamarck)

(1) At SW, the Baba Darves Formation is partially substituted by the Pull-i-Khumri Formation (Desio 1960).

In the same locality, in the mould of alteration, the specimens 61 AE-87/13 were collected and identified with:

Amphidonte columba (Lamarck)
Amphidonte conica (Sowerby)
Pycnodonte vesicularis (Lamarck)
Inoceramus sp. ind.
Thomasites sp. ind.

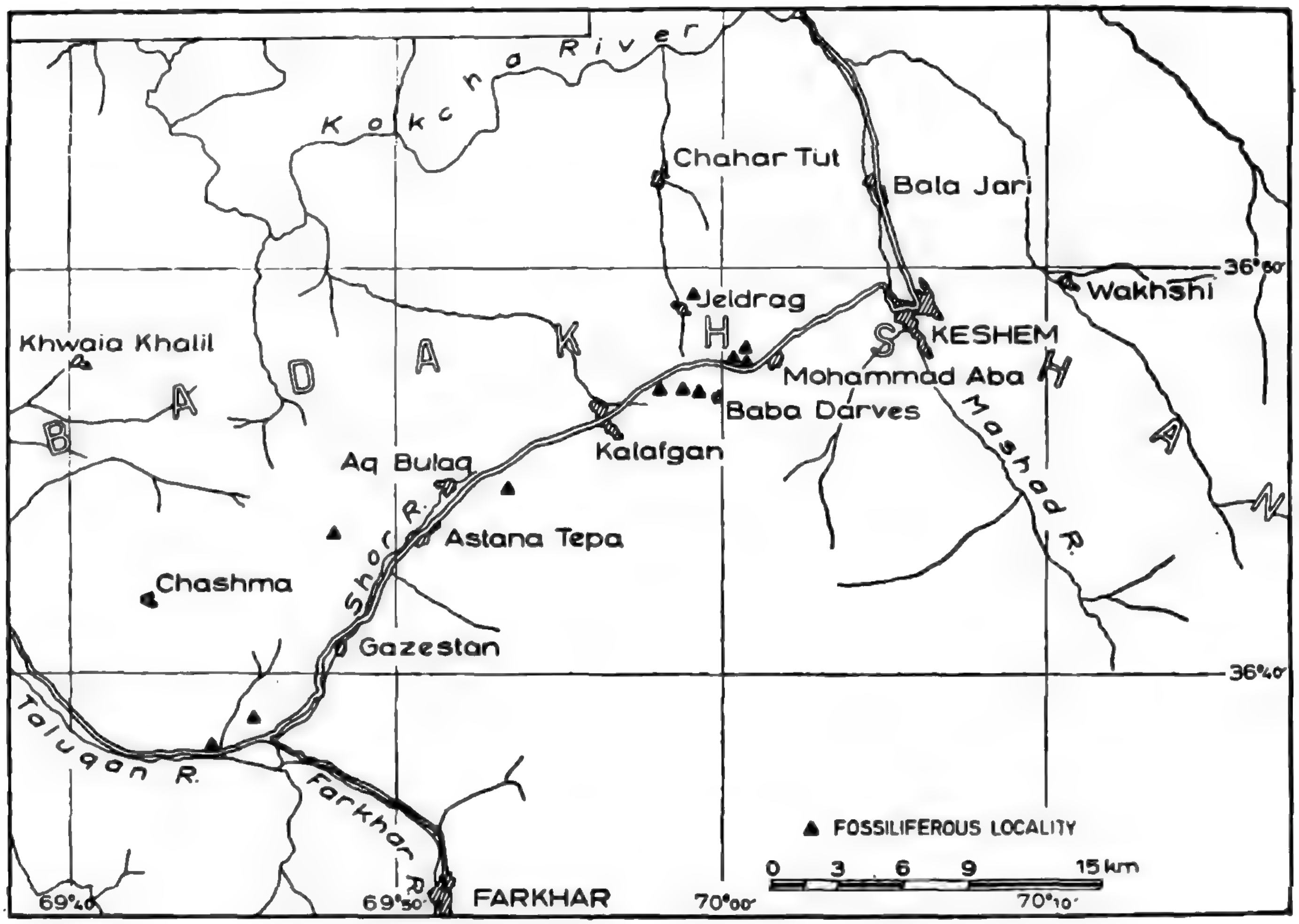


Fig. 1 - Sketch-map of the Upper Cretaceous fossiliferous localities.

Among the known species, *Pycnodonte vesicularis* occurs from the Albian to the Upper Senonian, *Amphidonte columba* from the Vraconian to the Turonian, and *Amphidonte conica* from the Albian to the Turonian. The genus *Thomasites* is characteristic of the Lower Turonian, thus it seems that we have sufficient elements to attribute the outcrop under consideration to the Turonian.

AQ BULAQ (fossiliferous locality not indicated in geological map) (61 AD-54) — In an area lying between the road junction for Farkhar and Aq Bulaq, over the Kalafgan salt mine, sample (61 AD-54) was collected, revealing the presence of:

Pycnodonte vesicularis (Lamarck) occurring from the Albian to the Upper Senonian.

AQ BULAQ (fossiliferous locality N. 7 of the geological map) (61 AE-69) — On the summit of the ridge north of the 1804.4 trigonometric point, 3 km east Aq Bulaq, the following fossils were collected in the grey limestone of the Baba Darves Formation:

Ceratostreon spinosum (Matheron) recorded in the Senonian
Arctica sp.

The diagnostic features are too poor to permit a precise dating of the outcrop.

BABA DARVES (fossiliferous localities N. 9, N. 8, N. 3 of the geological map) (61 AD-35, 61 AD-49, 61 AD-30) — In the western ridge of the trigonometric point 1891.7, south-east of the Chenar-i-Gunjeshkan Pass, at an altitude of 1780 m, in the brown and grey limestone of the Baba Darves Formation sample (61 AD-35) was collected, containing:

Amphidonte decussata (Goldfuss) recorded in the Campanian-Maastrichtian
Rectithyris subdepressa (Stoliczka), recorded in the Senonian

West of Baba Darves, at an altitude of 1850 m, a little further to the east of the trigonometric point 1891.7, between Kalafgan and Keshem, in the grey limestone of the Baba Darves Formation, sample (61 AD-49) were collected revealing the existence of the following:

Neithea (*Neitheops*) *quinquecostata* (Sowerby)
Lima canalifera Goldfuss
Exogyra overwegi von Buch
Exogyra sp. ind.
Pycnodonte vesicularis (Lamarck)
Rectithyris odiumensis Sahni
Rectithyris cf. *rotunda* Sahni
Rectithyris subdepressa (Stoliczka)

They are mostly forms covering a wide stratigraphic range, with the exception of the species of Brachiopods which are mainly limited to the Senonian.

In fact, *Neithea quinquecostata* occurs from the Albian to the Senonian, *Lima canalifera* from the Cenomanian to the Senonian, *Pycnodonte vesicularis* from the Albian to the Upper Senonian, while *Exogyra overwegi* has been recorded in the Maastrichtian.

Owing to the presence of these species, an Upper Cretaceous or more precisely, a Senonian age, can be attributed to the outcrops of these two localities near Baba Darves. In the south-eastern slope of the trigonometric point 1891.7, west of Baba Darves, and always in the brown and grey limestone of the Baba Darves Formation, sample (61 AD-30) was collected, containing:

Trigonarca sp. ind.
Pinna arata Forbes
Pecten sp. ind.
Neithea gibbosa (Pulteney)
Pycnodonte vesicularis (Lamarck)
Lopha sp. ind.
Arctica calabra (Seguenza)
Aphrodina cf. *plana* (Sowerby)
Ichthyosarcolites triangularis Desmarest
Ichthyosarcolites tricarinatus Parona
Rudists and Brachiopods indeterminable

Level 10:

Hippurites sp. ind.

Of the species quoted, several have a rather broad stratigraphical range, extending from the Aptian or the Albian to the Upper Senonian, such as *Pycnodonte vesicularis*, *Aphrodina plana*, and *Neithea gibbosa*, or from the Cenomanian to the Senonian, such as *Pinna arata*. Others have a more restricted range, being limited to the Cenomanian, e.g. *Arctica calabra*, *Ichthyosarcolites triangularis, Ichythyosarcolites tricarinatus*. The forms identified in this locality are few; on the basis of the data available the age would appear to be Cenomanian.

Baba Darves (fossiliferous locality not indicated in the geological map) (61 AD-37/1) — To the north of the previous localities, mainly to the north-west of Jeldragh, in the same Baba Darves Formation, sample (61 AD-37/1) was collected, containing Echinoids and:

Pycnodonte vesicularis (Lamarck) occurring from the Albian to Upper Senonian.

MOHAMMAD ABA (Keshem) (fossiliferous locality N. 5, N. 6, of the geological map) (61 AD-34, 61 AD-34/1) — 1 km west of Mohammad Aba, near the border pointer between Kataghan and Badakhshan, at an altitude of 1300 m, in the Baba Darves Formation, but from different beds, sample (61 AD-34) was collected, containing:

Trigonarca diceras (Seguenza)
Lima sp. ind.
Amphidonte conica (Sowerby)
Pycnodonte vesicularis (Lamarck)
Pycnodonte vesiculosa (Sowerby)
Ichthyosarcolites sp. ind.
Rudists indeterminable.

Trigonarca diceras is exclusive to the Cenomanian, *Pycnodonte vesiculosa* is recorded in the Cenomanian and in the Lower Turonian and *Amphidonte conica* occurs from the Albian to the Turonian with maximum frequency in the Cenomanian, *Pycnodonte vesicularis* ranges from the Aptian to the Upper Senonian.

2 km west of Mohammad Aba, on the hill north of the road, at an altitude of 1420 m and at the top of the series of beds cropping out there, in the same formation, the sample indicated with (61 AD-34/1) were collected, among which the following forms have been determined:

Pycnodonte vesicularis (Lamarck)
Trigonia sp. ind.
Aphrodina plana (Sowerby)
Sauvagesia sanfilippoi Parona
Ichthyosarcolites (not well preserved)
Haustator multiplicatus Pcelincev
Pleurotomaria sp. ind.
Trochactaeon matensis (Fittipaldi)

Of the above listed species only *Haustator multiplicatus* and *Trochactaeon matensis* are significant from the stratigraphical point of view. In fact the first occurs only in the Cenomanian, the latter in the Turonian. We have previously given a description of the other fauna with a wider range.

MOHAMMAD ABA (fossiliferous locality not indicated in the geological map) (61 AD-29) — The samples indicated with (61 AD-29) originate from a locality not far away from the north-west of Mohammad Aba (near the boundary line between Badakhshan and Kalafgan). The following species were identified, together with *Hippurites*:

Lima (*Acesta*) cf. *obsoleta* Dujardin
Pycnodonte vesicularis (Lamarck)

The first species occurs from the Cenomanian to the Upper Senonian, the second from the Aptian to the Upper Senonian.

The only elements with a significative stratigraphic value are found in the samples 61 AD-34 and 61 AD-34/1 which contain characteristic forms of the Cenomanian and Turonian; thus, we can consider that in the Mohammad Aba zone the Cretaceous series includes the Cenomanian-Turonian.

BETWEEN DARRA SARKHAO AND DOSHI (fossiliferous locality out of the geological map) (61 AD-68) — In an area much further south, between Darra Sarkhao and Doshi, rather far away from the others, in the Cretaceous limestone, named Massive Turonian limestone by Popol and Tromp (1954), the following forms were collected:

Pycnodonte vesicularis (Lamarck)
Pycnodonte vesiculosa (Sowerby)
Cardita nicaisei Coquand
Veniella sp. ind.

Pycnodonte vesiculosa is recorded in the Cenomanian and Lower Turonian, *Cardita nicaisei* only in the Cenomanian, *Pycnodonte vesicularis* from the Albian to Upper Senonian. The data we possess are very poor; however, the outcrop under consideration may be dated to the Cenomanian-Turonian.

CONCLUSIONS

The following conclusions can be drawn from the fore-going appraisal.

Paleontological studies of the Cretaceous of Afghanistan are extremely poor and are completely lacking in the zone under consideration, on which only a geological work by Desio, Martina and Pasquaré (1964) exists. For this reason the major part of the identified species, to be exact 17 out of 35 (48%) have not yet been found in Afghanistan, as can be seen from the following list: *Neithea gibbosa* (Pulteney), *Pinna arata* Forbes, *Trigonarca diceras* (Seguenza), *Lima canalifera* Goldfuss, *Lima* cf. *obsoleta* Dujardin, *Pycnodonte vesiculosa* (Sowerby), *Exogyra overwegi* von Buch, *Ceratostreon spinosum* (Matheron), *Cardita nicaisei* Coquand, *Arctica calabra* (Seguenza), *Ichthyosarcolites triangularis* Desmarest, *I. tricarinatus* Parona, *Haustator multiplicatus* Pcelincev, *Trochacteon matensis* (Fittipaldi), *Rectithyris odiumensis* Sahni, *R.* cf. *rotunda* Sahni, *R. subdepressa* (Stoliczka).

To these are added other forms, specifically unidentified owing to their imperfect preservation and the lack of material, which are as yet unknown in this area, belonging to the genus: *Trigonarca, Inoceramus, Lima, Exogyra, Lopha, Trigonia, Arctica, Veniella, Ichthyosarcolites, Pleurotomaria, Thomasites.*

The rest were already known in this area.

A Cenomanian-Turonian age has been attributed to the localities under consideration. This dating was difficult owing to the newness of the fauna, the lack of previous works and the scarcity of species in some localities, such as Farkhar and especially Aq Bulaq, where the presence of only one identified species and another unidentified one did not permit exact dating. Only the localities (61 AD-35) and (61 AD-49) of Baba Darves are not included in this dating: they occur in the Senonian.

PALEONTOLOGICAL DESCRIPTIONS

BRACHIOPODA

Class Articulata

Order Terebratulida

Superfamily Terebratulacea Gray, 1870

Family Terebratulidae Gray, 1840

Subfamily Rectithyridinae Muir-Wood, 1965

Genus **Rectithyris** Sahni, 1929

Rectithyris odiumensis Sahni, 1960

Pl. 16, fig. 2

1872 *Terebratula depressa cyrta* Stoliczka. *Cret. South. India Brachiop.*, p. 16, pl. II, fig. 7, 8.
1960 *Rectithyris odiumensis* Sahni. *Cret. Terebratulidae South. India*, p. 15, pl. I. fig. 7-12.

A bivalve internal mould, not very preserved. Shell massive, suboval, biconvex, with more or less equal convexity on both valves. Peduncular valve rounded, more long than broad, with width/length ratio of about 0,91. Hinge line curvilinear; anterior commissure rectimarginate. Umbo rather broad, short, not incurved and tangent to a vertical plane, with pedicle foramen mesothyridid.

Ornaments of fine growth-lines parallel to the anterior margin, more or less numerous, with faint radial ribs; under the microscope the shell appears punctate. Brachial valve circular, broad, with width/length ratio of about 0.90.

Dimensions —

		p.v.	b.v
Length	mm	40.5;	34.5
Width	mm	38 ;	31
Thickness	mm	19 ;	—
Apical angle		98° ;	—

Remarks — In the observations relative to the species, Sahni (1960, p. 15) makes interesting comparisons between the species under consideration and those morphologically similar, among which *Rectithyris subdepressa* (Stoliczka), also present in the material under study. The differences enumerated by Sahni were also found in the Afghanistan material, thus permitting the separation of the two species. In fact, *R. odiumensis* is distinguished by more triangular shape, lesser thickness, umbo broad and erect, and characteristic ornaments. Other Indian species are also ribbed, but less distinctively than the species under study. The erect and short umbo easily distinguishes *R. odiumensis* from the European species.

Occurrence — *Rectithyris odiumensis* Sahni is recorded in the Cenomanian (Utatur stage) and probably in the Senonian (Aryalur stage) in India.

Locality — West of Baba Darves. 61 AD-49.

Rectithyris cf. **rotunda Sahni, 1960**

Pl. 16, fig. 3

cf. 1960 ***Rectithyris rotunda*** **Sahni.** ***Cret. Terebratulidae South. India*****, p. 18, pl. II, fig. 5-10.**

Two internal moulds with traces of the shell, bivalve, fragmentary, of medium size. Shell massive, subpentagonal, biconvex. Peduncular valve with maximum convexity along the median line, running from the umbo to the anterior margin, flattening rapidly at the sides. Hinge line slightly curved; anterior commissure not visible in the specimens under consideration. Umbo relatively narrow, incurved, tangent to a vertical plane. Muscular field incomplete ovale, elongate, with faint muscle scars. Myophragm broad and deep. Ornaments of hardly visible and discontinuous radial lines. Brachial valve uniform and rather convex, not very well preserved.

Remarks — Both of the specimens under study are incomplete, lacking the anterior region; thus preventing any certain identification. The foramen, in the moulds studied only slightly distinct as it is filled up with calcareous infiltrations, clearly appears to belong to the mesothyridid type in the specimens illustrated by Sahni (1960, pl. II, fig. 5-10).

Occurrence — *Rectithyris rotunda* Sahni has been recorded in the Senonian in India (Aryalur stage).

Locality — West of Baba Darves. 61 AD-49.

Rectithyris subdepressa (Stoliczka, 1872)

Pl. 16, fig. 4

1872 *Terebratula subdepressa* Stoliczka. *Cret. South. India Brachiop.*, p. 16, pl. II, fig. 9, 11, 13, 15, 16; pl. III, fig. 1-8.

1922 *Terebratula subdepressa* Cottreau. *Paléont. Madagascar*, pt. X, p. 139, pl. I, fig. 7, 7 a.

1928 *Terebratula subdepressa* Parona. *Faune Cret. Caracorum*, p. 137.

1960 *Rectithyris subdepressa* Sahni. *Cret. Terebratulidae South. India*, p. 16, pl. I, fig. 13-18.

Eight internal moulds with traces of the shell, bivalve, medium in size, well preserved. Shell massive, suboval, biconvex. Peduncular valve rather convex especially at the umbonal region, with round outline, more long than broad, with width/length ratio between 0,85 and 0,95. Hinge line curvilinear rather short; anterior commissure rectimarginate. Umbo narrow and strongly incurved, tangent to a vertical plane, foramen mesothyridid. Muscular field oval, elongate, with well marked diductor muscle scars and divided by a broad and deep myophragm which runs from the umbo up to two-thirds of the valve length. At first sight the valve seems to be smooth externally, under the microscope it is finely punctate.

Brachial valve with circular outline, with length/width ratio = 1, weakly convex. Cardinal and anterior commissures corresponding to those of the peduncular valve. Adductor muscle scars faintly marked. Ornaments of concentric growth-lines.

Dimensions —	Length	mm	34.0;	47.0
	Width	mm	29.0;	45.0
	Thickness	mm	16.5;	25.0
	Apical angle		85° ;	—

Remarks — Between the specimens under consideration, the biggest, lenticular in shape, circular in outline, more flattened, resembles more the specimens of the species illustrated by Sahni (1960, pl. I, fig. 13-18), and to the adult forms figured by Stoliczka (1872, pl. III, fig. 8). The shortest more complete specimen on the other hand is more similar to the samples of Stoliczka (1872, pl. II, fig. 13), in the outline, which is more oval. It presents the foramen of the umbo filled up with calcareous infiltrations, a myophragm strongly marked and a sulcus which runs parallel and near the anterior margin of the brachial valve, probably due to an arrest of the growth-lines.

Occurrence — *Rectithyris subdepressa* (Stoliczka) is recorded in the Senonian (Aryalur stage) in India, Madagascar and Karakorum.

Locality — West of Baba Darves (61 AD-49); Northern slope of Baba Darves (61 AD-35).

MOLLUSCA

Class Bivalvia

Subclass Pteriomorphia

Order Arcoida

Superfamily Arcacea Lamarck, 1809

Family Cucullaeidae Stewart, 1930

Genus **Trigonarca** Conrad, 1862

Trigonarca diceras (Seguenza, 1882)

1882 *Arca diceras* Seguenza. *Cret. Italia Merid.*, p. 96, pl. XIV, fig. 1 a-b.
1912 *Arca (Trigonarca) diceras* Pervinquière. *Etude Paléont. Tunisienne*, p. 102, pl. VII, fig. 23, 25, 26.
1918 *Arca (Trigonarca) diceras* Greco. *Fauna Cret. Egitto*, pt. III, p. 29, pl. III, fig. 14, 15.
1928 *Arca (Trigonarca ?) diceras* Parona. *Faune Cret. Caracorum*, p. 120, pl. XV, fig. 2, 2a.
1937 *Arca (Trigonarca) diceras* Trevisan. *Cenom. Sicilia occ.*, p. 48, pl. II, fig. 12, 13.
1958 *Trigonarca diceras* Russo. *Lamell. Cenom. Barcellona*, p. 19, pl. V, fig. 4-8

Only one medium-sized left valve, not very well preserved, but in which the essential characters of Seguenza's species are easily visible.

Triangular inequilateral valve, very broad towards the ventral margin, more long than high, rather thick and convex. A thick carina runs obliquely from the umbo to the postero-ventral corner of the shell; a sulcus almost parallel to the carina, well shown mainly in the ventral region. Umbo prominent, broad, truncate and carinated.

Remarks — The very broad shape, the postero-dorsal margin almost parallel to the ventral margin, the well marked carina, and the strong thickness show a similarity to the Pervinquière specimen (1912, pl. 7, fig. 25) indicating a transitional form from *Trigonarca diceras* to *Arca parallela* Coquand. Pervinquière (p. 103) seems to be favourable to the idea of grouping these two species, owing to their strong morphological similarity.

Occurrence — *Trigonarca diceras* (Seguenza) is recorded in the Cenomanian in southern Italy, Sicily, Algeria, Tunisia, Tripolitania, Egypt, Karakorum.

Locality — 1 km west of Mohammad Aba (Keshem). 61 AD-34.

Trigonarca sp. ind.

Pl. 12, fig. 1

An inequilateral left valve with a subtriangular, almost sub-quadrangular outline, more long than high, weakly convex, with maximum convexity along the posterior side, thus forming a kind of a carina.

Its imperfect preservation does not permit a more detailed description and specific attribution. Freneix and Dartevelle (1957, p. 24) distinguish several groups belonging to the genus *Trigonarca*; the specimen under consideration seems to be similar to the II group var. A, having as a type *Trigonarca curvatodonta* Dartevelle & Freneix, in the sub-median umbo, slightly prominent and feebly incurved, in the weakly umbo-ventral carina, and in a slightly broad and posteriorly truncate valve.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Order Mytiloida

Superfamily Pinnacea Leach, 1819

Family Pinnidae Leach, 1819

Genus **Pinna** Linnaeus, 1758

Pinna arata Forbes, 1846

Pl. 12, fig. 2

1846 *Pinna arata* Forbes. *Invert. South. India*, p. 153, pl. XVI, fig. 10.
1871 *Pinna arata* Stoliczka. *Cret. South. India Pelecyp.*, p. 384, pl. XXIV, fig. 5; pl. XXV, fig. 1; pl. XXVI, fig. 5.
1954 *Pinna arata* Baroni, Incitti, Oliveri, Viola. *Neocret. Libia*, p. 12, pl. I, fig. 1 a-c.

Only one fragment of a large left valve, very convex, with weak convergent lateral margins giving a lanceolate outline. Ornament comprising prominent radial ribs separated by much wider interspaces and crossed by hardly visible, thin, close and longitudinal riblets. However these few elements are sufficiently characteristic to permit its attribution to Forbes' species.

Remarks — The specimen under consideration is similar to the specimen represented by Stoliczka (1871, pl. XXVI, fig. 5), but differs in the lack of concentric growth-lines which cross the radial ribs, this absence being due to the imperfect preservation.

Another morphologically similar species is *Pinna decussata* Goldfuss, which, however, differs in the absence of thin riblets and concentric growth-lines.

Occurrence — *Pinna arata* Forbes is recorded in the Upper Cretaceous in Somaliland, Libya and in the eastern coast of Madagascar; in the Cenomanian and Turonian in India and Karakorum.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Order Pterioida

Suborder Pteriina

Superfamily Pteriacea Broderip, 1839

Family Inoceramidae Zittel, 1881 (I.C.Z.N. 473)

Genus **Inoceramus** Sowerby, 1814

Inoceramus sp. ind.

A rather large left valve, incompletely preserved. Valve inequilateral, oval-rounded, narrowing towards the umbonal region, weakly convex, with maximum convexity at the medio-dorsal region. The anterior and posterior margins, as far as one can see, oblique, the anterior one longer and more inclined than the posterior one; ventral margin rather broadly rounded.

Umbo terminal slightly incurved and weakly differentiated from the rest of the surface. The ornaments are of concentric, close and regular ridges in the posterior region, more spaced out, marked and deformed by lumps in the ventral region, not visible in the anterior region.

Remarks — The specimen under consideration is like *Inoceramus labiatus latus* Sowerby, described and figured by Rossi Ronchetti (1961, pl. XXVII fig. 1, 2) at Pull-i-Khumri.

Locality — Road junction to Farkhar. 61 AE-87/13.

Superfamily PECTINACEA Rafinesque, 1815

Family PECTINIDAE Rafinesque, 1815

Subfamily PECTININAE Rafinesque, 1815

Genus **Neithea** Drouet, 1825

Neithea gibbosa (Pulteney, 1813)

Pl. 12, fig. 6

1813 *Pecten gibbosus* Pulteney. *Dorsetshire*, p. 107, pl. I (fossil), fig. 2.
? 1813 *Pecten planatus* Pulteney. *Dorsetshire*, p. 107, pl. I (fossil), fig. 3.
1814 *Pecten quadricostatus* Sowerby. *Mineral-Conchol.*, vol. I, p. 122, pl. LVI, fig. 1, 2.
1903 *Pecten* (*Neithea*) *quadricostatus* Woods. *Cret. Lamell. England*, p. 210, pl. XL, fig. 6, 7; text-fig. 3-5.
1916 *Neithea quadricostata* Newton. *Brachiop. Moll. Angola*, p. 568, pl. I, fig. 8.
1939 *Neithea quadricostata* Tavani. *Foss. Cret. Zululand*, p. 6, pl. I, fig. 1, 2.
1940 *Neithea gibbosa* Cox. *Cret. Moll. Pulteney*, p. 124, pl. 7, fig. 2, 3.
1957 *Neithea gibbosa* Dartevelle and Freneix. *Moll. Crét. Cameroun Angola*, p. 73.

A fragment of a medium-sized left valve imperfectly preserved, rather broad and flattened, with broadly rounded ventral margin. Ornament hardly visible, consisting of primary and secondary ribs; between two primary ribs one can see, with difficulty, three intercalated secondary similar ribs.

Remarks — *Neithea quadricostata* (Sowerby) has been included in the synonymy of the species under examination by Cox (1940), who was of the opinion that the two forms were identical. Pictet and Campiche (1868-71) separated under the name of *Janira faujasi* Pictet & Campiche, *Janira quadricostata* d'Orbigny of the Upper Cretaceous, as it shows unequal intermediate ribs and an apical angle of 70° instead of 80°.

Occurrence — *Neithea gibbosa* (Pulteney) is recorded in the Cenomanian in England, Germany, Turkey, Zululand; in the Albian in Angola. According to Dartevelle and Freneix, the species ranges from the Albian up to the Lower Senonian.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Subgenus **Neitheops** Stewart, 1930

Neithea (Neitheops) quinquecostata (Sowerby, 1814)

Pl. 12, fig. 5

1814 *Pecten quinquecostatus* Sowerby. *Mineral-Conchol.*, vol. I, p. 122, pl. LVI, fig. 4-8.
1906 *Pecten* (*Neithea*) *quinquecostatus* Woods. *Cret. Pondoland*, p. 298, pl. XXXV, fig. 14.

1925 *Pecten (Neithea) quinquecostatus* Bion in Bion and Coggin Brown. *Cret. Afghanistan*, p. 268.
1946 *Neithea quinquecostata* Stchepinsky. *Foss. Turquie*, p. 122, pl. XIV, fig. 7, 8.
1959 *Neithea quinquecostata* Yabe. *Cret. Pelecyp. Afghanistan*, p. 289, pl. I, fig. 1-4.
1960 *Neithea quinquecostata* Muromzieva in Drushchiza and Kudrjavzeva. *Cret. Lower Caucasus Crimea*, p. 191, pl. XI, fig. 10-12.
1961 *Neithea quinquecostata* Soares. *Lamell. Cret. Benguela-Cuio*, p. 25, pl. V, fig. 16.
1961 *Neithea (Neitheops) quinquecostata* Rossi Ronchetti and Albanesi. *Cenom. Gebel Tripolitano*, p. 271, pl. XX, fig. 5, 6 (*cum syn.*).
1961 *Neithea quinquecostata* Bobkova. *Lamell. Upper Cret.*, p. 110, pl. IV, fig. 1-3.
1965 *Neithea quinquecostata* Cieslinski. *Cenom. Poland*, p. 31, pl. IV, fig. 2 a-b.

A rather well preserved, subequilateral, triangular, flattened, medium-sized left valve, very broad at the ventral margin. Anterior and posterior margins oblique and straight, extending above mid-height, ventral margin undulated. Umbonal region slightly visible. Ornaments of primary and secondary ribs more evident in the dorsal than in the lateral region. The primary ribs are 6, separated one from the other by 3 or 4 secondary thinner and different ribs. The primary ones are longer, thus giving the ventral margin an irregular aspect.

Remarks — The left valve of the species under study differs from that of *Neithea gibbosa* (Pulteney) in the number and character of the secondary ribs. In fact, in Pulteney's species, there are only three secondary, identical ribs, rather than 3 or 4 different ones as in *Neithea quinquecostata*.

Occurrence — *Neithea quinquecostata* (Sowerby) occurs from the Albian to the Senonian in Europe, Asia, Africa, Madagascar and America. In Afghanistan it has been recorded by Yabe in the Upper Cretaceous, and by Bion from the Lower Greensand to the Upper Chalk.

Locality — West of Baba Darves. 61 AD-49.

Genus **Pecten** Müller, 1776

Pecten sp. ind.

Pl. 12, fig. 7

1959 *Pecten* sp. Yabe. *Cret. Pelecyp. Afghanistan*, p. 294, pl. IV, fig. 1, 2.

A big fragment of a right valve, slightly eroded and lacking in auricles, similar in form and ornaments to the specimens, also fragmentary, described by Yabe (1959).

Obtuse triangle-like valve, relatively restricted and sharp in the umbonal region, broad towards the ventral margin, with maximum length at about two-thirds total height. Anterior margin oblique and straight, meeting the curvilinear ventral margin at a broad angle. Posterior margin not visible. Ornaments of very coarse and rounded radial ribs, brought closer towards the umbo, then gradually distancing and inflating towards the ventral margin, separated by rather deep, intercostal spaces of almost twice the width of the ribs. In the intercostal spaces fragments of shell are also visible, which however, are lacking on the ribs.

Remarks — The Afghanistan specimen, though very similar to *Pecten* sp. Yabe, presents also a certain affinity with *Pecten* (*Vola*) *karmeliticus* figured and described by Blanckenhorn (1934); it differs however from the latter in having a lesser number of ribs and broader intercostal spaces. Some similarity can also be seen with *Pecten beaveri* Sowerby, but the latter has a more rounded form, a shorter anterior margin, and closer ribs.

De Lapparent and De Lavigne Sainte-Susanne (1964, p. 251) identify *Pecten* sp. Yabe with *Lima gallieni* d'Orbigny; but the specimen under consideration, as well as those recorded by Yabe are so very spoiled and incomplete, that they cannot be included with any certainty in d'Orbigny's species.

Occurrence — *Pecten* sp. Yabe is recorded in Afghanistan in the Senonian.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Superfamily Limacea Rafinesque, 1815

Family Limidae Rafinesque, 1815

Genus **Lima** Bruguière, 1797

Lima canalifera Goldfuss, 1836

Pl. 12, fig. 4

1836 *Lima canalifera* Goldfuss. *Petrafacta Germaniae*, p. 89, pl. CIV, fig. 1.
1904 *Lima canalifera* Woods. *Cret. Lamell. England*, vol. II, p. 1, pl. I, fig. 1-7 (*cum syn.*).
1934 *Lima canalifera* Andert. *Kreideabl. Elbe Ieschken*, p. 145, pl. 8, fig. 6.
1942 *Lima canalifera* Stchepinsky. *Faune crét. Turquie*, p. 56, pl. V, fig. 1, 2.
1960 *Lima canalifera* Muromzieva in Drushchiza and Kudrjavzeva. *Cret. Lower Caucasus Crimea*, p. 194, pl. XII, fig. 10 a-b.

A single left valve lacking the auricles and the umbonal region. Because of the shape and ornaments the specimen seems, however, to be attributable to *Lima canalifera* Goldfuss. Inequilateral valve, more high than long, with a suboval rounded outline, except for the antero-dorsal margin which is more straight and elongate. Dorsal surface asymmetric, moderately convex, sloping down with almost equal inclination on the respective antero and postero-dorsal margins.

Ornaments of 24 straight and rounded ribs, separated by broad sulcus, closer in the umbonal region, assuming a fan-like shape towards the ventral margin. Lines of concrescence slightly marked, protruding at regular intervals.

Remarks — Woods points out the great differences as regards the morphological features and the stratigraphic distribution between the specimens of *Lima canalifera* recorded in England and those of other localities. According to Woods the number of the English specimens' ribs varies from 14 to 21; Andert (1934), on the other hand, records 24 ribs, as in the specimen we have considered.

Occurrence — *Lima canalifera* Goldfuss has been recorded in the Cenomanian in England and Poland, in the Turonian-Senonian in Germany, in the Cenomanian-Turonian-Senonian in Turkey; in Lower Cretaceous in Caucasus and Crimea.

Locality — West of Baba Darves. 61 AD-49.

Lima sp. ind.

An incomplete left valve does not permit a specific identification; its attribution to the genus *Lima* is based on its oval outline, imperfect convexity, and characteristic ornaments. The dorsal surface is, in fact, crossed by regular radial ribs, broader than the intercostal furrows, dense in the umbonal region, while they are more spaced out at the ventral region.

A comparison with the other two species of *Lima* found in the Afghanistan material reveals that the specimen under consideration belongs to an intermediate position between the two because of the form and ornaments; it is in fact more elongated and presents more marked and closer ribs than *Lima canalifera* Goldfuss, while it is more rounded and the ribs are more spaced out than *Lima* (*Acesta*) cf. *obsoleta* Dujardin.

Locality — 1 km west of Mohammad Aba (Keshem). 61 AD-34.

Subgenus **Acesta** H. & A. Adams, 1858

Lima (Acesta) cf. **obsoleta** Dujardin, 1837

Pl. 12, fig. 3

cf. 1837 *Lima obsoleta* Dujardin. *Touraine*, p. 227, pl. XXVI, fig. 6.
cf. 1857 *Lima* (*Acesta*) *obsoleta* Dartevelle and Freneix. *Moll. Crét. Cameroun Angola*, p. 98, pl. XII, fig. 8-11.

A left valve whose umbonal region and auricles are in part broken and in part covered by a not removable rock, and a medio-dorsal region of a valve impression, do not permit certain identification with Dujardin's species.

Inequilateral valve, oval outline narrowed towards the umbo, much higher in proportion to its length, moderately convex. The ornaments comprising 26 radial ribs are well visible, of which only some are dichotomous, broad and flat, separated by rather deep sulci. The ribs, close in the umbonal and anterior region, get enlarged towards the ventral margin; gibbosities and tumidities are also present.

Remarks — The differences between the species under consideration and *Lima canalifera* Goldfuss, also present in the material under study, are very clear, even though the specimens are incomplete; they consist in the more elongate oval outline, in the narrower umbonal region, in the more marked and closer ribs in *Lima obsoleta* Dujardin. The specimen under examination is very similar in outline and ornaments to that of the specimen figured by Dartevelle and Freneix (1957, pl. XII, fig. 11).

Occurrence — *Lima obsoleta* Dujardin is recorded in the Lower Senonian in France, in the Cenomanian-Turonian-Senonian in Low Belgian Congo and Northern Angola, in the Senonian in Gabon.

Locality — North-West of Mohammad Aba. 61 AD-29.

Suborder Ostreina

Superfamily Ostreacea Rafinesque, 1815

Family Ostreidae Rafinesque, 1815 (I.C.Z.N. 356)

Genus **Amphidonte** Fischer von Waldheim, 1829

Amphidonte columba (Lamarck, 1819)

Pl. 12, fig. 8; Pl. 13, fig. 1, 2

1819 *Gryphaea columba* Lamarck. *Animaux sans vertèbres*, vol. VII, p. 198.
1913 *Exogyra columba* Woods. *Cret. Lamell. England*, vol. II, p. 413, tex-fig. 243-248.
1928 *Exogyra columba* Parona. *Faune Cret. Caracorum*, p. 126, pl. XIV, fig. 6, 6 a.
1961 *Exogyra columba* Rossi Ronchetti and Albanesi. *Cenom. Gebel Tripolitano*, p. 274, pl. XX, fig. 11; pl. XXI, fig. 1-3 (*cum syn.*).
1961 *Exogyra columba* Rossi Ronchetti. *Foss. Cret. Pull-i-Khumri*, p. 354, pl. XXVII, fig. 9-11.
1961 *Amphidonta columba* Bobkova. *Ostreids Tajik Depression*, p. 13, pl. XXXII, fig. 1-4.
1963 *Exogyra columba* Henriques da Silva. *Lamell. Cret. Angola*, p. 26, pl. V, fig. 27, 28.
1963 *Exogyra columba* Fawzi. *Cénom. Egypte*, p. 40, pl. III, fig. 1-10.
1964 *Amphidonta columba* Rengarten. *Ostreidae Cret. Caucasus minor*, p. 49, pl. VII, fig. 2 a-b.

About ten left valves and some fragments of massive left valves of various dimensions, rather well preserved. Very convex left valve, rather inequilateral, exogyre, with a trigonal outline, more or less swollen in the ventral region, often more high than long, with length/height ratio = 0.87. Anterior margin slightly convex, posterior margin sunken under the umbo, then oblique; ventral margin subcircular. In the most specimens the antero-ventral region is more developed than the postero-ventral, only in two specimens can the contrary be seen. On the dorsal surface a curved ridge is hardly visible, running from the umbo to the postero-ventral region. Umbo developed, prominent, spirally twisted, opisthogyre.

Ornaments, when visible, formed of concentric growth-lines; but generally the external surface of the valve is smooth.

Dimensions —	Height mm	65 ;	64 ;	48 (87%);	40
	Length mm	60 (92%);	54 (84%);	55 ;	38 (95%)

Occurrence — *Amphidonte columba* (Lamarck) occurs from the Vraconian to the Lower Turonian, with maximum frequency in the Cenomanian, in Europe, North Africa, Syria, Palestine, the Niger territory, Eastern Africa, Madagascar, Southern India, Perù, California, Tajik Depression, Afghanistan, Caucasus.

Locality — Road junction to Farkhar. 61 AE-87/11; 61 AE-87/13.

Amphidonte conica (Sowerby, 1813)

Pl. 13, fig. 3, 4

1813 *Chama conica* Sowerby. *Mineral-Conchol.*, vol. 1, p. 69, pl. XXVI, fig. 3.
1837 *Amphidonte conica* Push. *Polens Paläont.*, p. 39.
1913 *Exogyra conica* Woods. *Cret. Lamell. England*, vol. II, p. 407, text-fig. 215-242.
1961 *Exogyra conica* Rossi Ronchetti and Albanesi. *Cenom. Gebel Tripolitano*, p. 275, pl. XXI, fig. 4-6 (*cum syn.*).
1961 *Exogyra conica* Rossi Ronchetti. *Foss. Cret. Pull-i-Khumri*, p. 354, pl. XXVII, fig. 12-13.
1962 *Exogyra conica* Abbass. *Egypt. Cret. Pelecyp.*, p. 67, pl. IX, fig. 12.
1963 *Exogyra conica* Fawzi. *Cénom. Egypte*, p. 39, pl. IV, fig. 1-3.
1964 *Amphidonta conica* Mirkamalov. *System. Position Amphidonta*, p. 149, pl. XIV, fig. 6-8.

Five massive left valves, rather well preserved with shell fragments, one of large and the others of small dimensions, and two incomplete left valves. Inequilateral left valve, subtriangular inflated, much higher than long, with length/height ratio = 0.87, very convex with maximum convexity in the medio-dorsal region sloping down more rapidly towards the antero-dorsal margin, more slowly on the postero-dorsal one. Anterior margin regularly convex, passing evenly to the ventral margin; postero-dorsal margin sunken under the umbo, then becoming slightly visible; ventral margin broadly rounded.

Dorsal surface protruding posteriorly in the ventral region, bearing a curved median keel, extending from the umbo to the postero-ventral corner. Umbo prominent, twisted, with sharp beack. The ornaments are lacking, the surface is completely smooth.

Dimensions —	Height	mm 62 ;	37
	Length	mm 54 (87%);	?

Remarks — The biggest specimen is very similar to the one figured by Woods (1913, text-fig. 228); in it, the keel is rather well marked in the umbonal region, but it disappears gradually before reaching the ventral margin. The smallest specimens are very similar to those collected at Pull-i-Khumri, figured by Rossi Ronchetti (1961, pl. XXVII, fig. 12, 13).

Occurrence — *Amphidonte conica* (Sowerby) occurs in the Albian and Cenomanian in Europe, Northern Africa, Nigeria, Syria, Palestine, Turkey, and Afghanistan. Only in Madagascar it occurs in the Turonian.

Locality — 1 km west of Mohammad Aba (Keshem) (61 AD-34); road junction to Farkhar (61 AE-87/13).

Amphidonte decussata (Goldfuss, 1834)

Pl. 13, fig. 5

1834 *Exogyra decussata* Goldfuss. *Petrafacta Germaniae*, p. 33, pl. LXXXVI, fig. 11 a-c.
1869 *Exogyra decussata* Coquand. *Ostrea Terr. Crét.*, p. 30, pl. VII, fig. 1-16.
1923 *Exogyra decussata* Parona. *Neocret. Tripolitania*, pt. II, p. 30, pl. IX, fig. 6, 7.
1925 *Exogyra decussata* Bion in Bion and Coggin Brown. *Cret. Afghanistan*, p. 266.
1961 *Exogyra decussata* Bobkova. *Ostreids Tajik Depression*, p. 120, pl. XXIX, fig. 3-5.
1964 *Amphidonta decussata* Rengarten. *Ostreidae Cret. Caucasus minor*, p. 48, pl. VI, fig. 10 a-c; pl. VII, fig. 1 a-b.

A single medium-sized left valve, rather well preserved, with shell fragments. Inequilateral left valve, exogyre, with trigonal outline, narrow in the umbonal region, protruding in the ventral one, more high than long, with length/height ratio = 0.77, very convex, with maximum convexity in the medio-dorsal region, sloping slightly on the antero-dorsal margin, steeply on the postero-dorsal one.

Antero-dorsal margin almost straight, forming a right angle with the ventral one; postero-dorsal margin sunken under the umbo, then oblique and meeting the broadly curved ventral margin in an acute angle.

Dorsal surface smooth and asymmetrical, with a curved carina running from the umbo to the ventral margin, delimiting a narrow but ventrally elongated posterior side, semi-circular, almost vertical on the respective margin; anterior side extended sloping gently and forming an almost right angle with the posterior side.

Umbo rather well developed, narrow, very incurved forward, with a slight helicoidal winding.

Dimensions — Height mm 44
Length mm 34 (77%)

Remarks — From what we are able to note on examination of the Afghanistan specimen the Goldfuss's species differs from *Exogyra overwegi*, in the greater size and the more trigonal form, in the less developed helicoidal winding of the umbo, in the minor steepness of the anterior side and lastly in the minor development of the postero-ventral surface. The Afghanistan specimen resembles the shell figured by Parona (1923, pl. IX, fig. 6), but lacks the characteristic « piegoline ondulate », also because it is almost entirely worn. It is only in the umbonal region where this typical ornament is slightly noticeable.

Occurrence — *Amphidonte decussata* (Goldfuss) occurs in the Campanian and Maastrichtian in Western Europe, Northern Africa, Central Asia, Crimea, Caucasus minor, in the Tajik Depression, and in Afghanistan.

Locality — Northern slope of the Baba Darves. 61 AD-35.

Genus **Ceratostreon** Bayle, 1878

Ceratostreon spinosum (Matheron, 1842)

Pl. 13, fig. 6, 7

1842 *Exogyra spinosa* Matheron. *Foss. Bouches du Rhône*, p. 192, pl. XXXII, fig. 6, 7.
1846 *Ostrea matheroniana* d'Orbigny. *Paléont. Franç.*, vol. III, p. 737, pl. 485, fig. 4-7.
1869 *Ostrea plicifera* Coquand. *Ostrea Terr. Crét.*, p. 80, pl. XXXVI, fig. 9, 10.
1961 *Ceratostreon spinosum* Bobkova. *Ostreids Tajik Depression*, p. 126, pl. XXX, fig. 2-6.

About ten small left valves, incompletely preserved and fragmentary; inequilateral, weakly convex, exogyre, with very varied form, generally auricolar, variable in proportions, but usually higher than long. Margins rather sharp and unundulated. Dorsal surface asymmetrical and uneven by some gibbosities, bearing a more or less accentuated carina, brought forward and in some specimens regularly curved; less evident and with a more irregular course in others. The region between the carina and the antero-dorsal margin is rather narrow and steep; posterior region more extended, weakly inclined over the relative margin. In the specimens with a more median carina, the valve appears to be more convex and the dorsal surface slopes with almost equal inclination on both the margins. Umbo exogyre and opistogyre.

External surface smooth and ornated by some ribs; sometimes with ridges and gibbosities. Internal surface, nearly always invisible; in two specimens it is smooth and moon-shaped.

Dimensions —	Height	mm	25.5 ;	18 ;	17.5
	Length	mm	19.5 (76%);	12 (66%);	9.0 (51%)

Remarks — One specimen is clearly recognisable from the previous described by its smooth posterior side, falling very steeply on the respective margin, the anterior side slightly less inclined, crossed by three or four broad, rough, prominent and well spaced out ribs, more or less parallel to one another and oblique to the carina from which they seem to rise. For these reasons, even though it remarkably resembles *Ceratostreon spinosum*, I am very doubtful about its determination.

Occurrence — *Ceratostreon spinosum* (Matheron) is recorded in the Senonian in France, England, Spain, Crimea; in the Campanian and Maastrichtian in Algeria, Tunisia, and the Tajik Depression.

Locality — 3 km east of Aq Bulaq. 61 AE-69.

Genus **Exogyra** Say, 1820

Exogyra overwegi von Buch, 1852

Pl. 13, fig. 8, 9

1852 *Exogyra overwegi* von Buch in Beyrich. *Reise Tripoli*, p. 154, pl. I, fig. 1.

1943 *Exogyra overwegi* Rossi. *Exogyra overwegi*, p. 1, pl. I, fig. 1, 7 (*cum syn.*).

1962 *Exogyra overwegi* Rossi Ronchetti. *Exogyra overwegi Maestricht. Libico*, p. 193, pl. 14-18.

1962 *Exogyra overwegi* Abbass. *Egypt. Cret. Pelecyp.*, p. 70, pl. IX, fig. 9, 11.

Three medium-sized left valves, rather well preserved, together with another incomplete left valve. Inequilateral valve, exogyre, oval, rather high and narrow, with a regularly curved antero-dorsal margin starting from the umbo up to the junction with the ventral one; postero-dorsal margin slightly rounded, almost straight. Umbonal region rather narrow, ventral region more extended. Anterior side steep, semi-circular, almost forming a right angle with the posterior one. Posterior side moderately inclined, slightly protruding ventrally. The two sides are separated by a curved and rounded submedian ridge starting from the umbo and ending before the postero-ventral margin. Umbo rather well developed, helicoidal, coiled ventrally and backwards. Ornaments of concentric growth-lamellae.

Dimensions —	Height	mm 22 ;	20
	Length	mm 14 (?);	16 (80%)

Remarks — *Exogyra overwegi* von Buch is largely diffused and debated by various authors owing to its variability which has often led to the separation of different varieties, whose validity has been disaffirmed by a recent statistic work held by Rossi Ronchetti (1962).

Occurrence — *Exogyra overwegi* von Buch is recorded in the Maastrichtian in Northern Africa (Libya, Egypt, Algeria, Tunisia), British Somaliland, Madagascar, India, Spain, Sicily.

Locality — West of Baba Darves. 61 AD-49.

Exogyra sp. ind.

Pl. 12, fig. 9

A single large bivalve specimen, not very well preserved with shell fragments, massive with thickness equal to about 45 mm, inequivalve, right valve slightly visible, flatter than the left one. Inequilateral left valve, subtriangular, very extended ventrally, with length exceeding the height, the ratio H/L being equal to about 0.93, very convex, with maximum convexity in the medio-dorsal region, sloping down rapidly on the postero-dorsal margin, gently on the antero-dorsal. Antero-dorsal margin regularly curved forming almost a semicircumference with the ventral one; postero-dorsal margin slightly sunken under the umbo, then oblique.

Dorsal surface crossed by a curved median ridge running from the umbo to the postero-ventral corner, separating sharply the anterior side from the posterior one which is less inflated. Umbo prominent, bent towards the posterior side, but not helicoidally. Ornaments of large radial ribs, well marked, but left only in some part of the surface, and marked concentric lamellae.

Dimensions —	Height	mm 65 (93%)
	Length	mm 70
	Thickness	mm 45

Remarks — The specimens under consideration can be distinguished from the other Afghanistan ones assigned to genus *Exogyra*, by its remarkable size, minor development and the limited spiral winding of the umbo, and the presence of radial ribs. The imperfect preservation of a single mould permits neither a precise identification nor the institution of a new species.

Locality — West of Baba Darves. 61 AD-49.

Genus **Lopha** Röding, 1798

Lopha sp. ind.

A single left valve fragment does not permit specific identification, but only the attribution to the genus *Lopha*. In fact some of its features resemble that genus, such as the subcircular outline, the remarkable convexity of the left valve, the ribs diverging radially from a median curved line, and being large, sharp, well marked towards the centre and attenuated on the sides, separated by broad grooves.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Genus **Pycnodonte** Fischer von Waldheim, 1835

Pycnodonte vesicularis (Lamarck, 1806)

Pl. 14, fig. 1-4

1806-09 *Ostrea vesicularis* Lamarck. *Foss. env. Paris*, vol. VIII (1806), p. 160; vol. XIV (1809), p. 375, pl. XXII, fig. 3.
1925 *Gryphaea vesicularis* Bion in Bion and Coggin Brown. *Cret. Afghanistan*, p. 265.
1946 *Pycnodonta vesicularis* Stchepinsky. *Foss. Turquie*, p. 125, pl. XVII, fig. 2, 4.
1954 *Pycnodonta vesicularis* Salvan. *Invert. Phosphates Maroc.*, p. 15, pl. VIII, fig. 4.
1961 *Pycnodonta vesicularis* Rossi Ronchetti. *Foss. Cret. Pull-i-Khumri*, p. 353, pl. XXVII, fig. 8 (*cum syn.*).
1961 *Gryphaea vesicularis* Bobkova. *Ostreids Tajik Depression*, p. 69, pl. XI, fig. 1-5.
1961 *Pycnodonta vesicularis* Soares. *Lamell. Cret. Benguela-Cuio*, p. 35, pl. II, fig. 7-9; pl. IV, fig. 14.
1962 *Pycnodonta vesicularis* Abbass. *Egypt. Cret. Pelecyp.*, p. 61, pl. X, fig. 1, 2.
1963 *Pycnodonta vesicularis* Henriques da Silva. *Lamell. Cret. Angola*, p. 28, pl. V, fig. 29, 30.
1964 *Pycnodonta vesicularis* Rengarten. *Ostreidae Cret. Caucasus minor*, p. 22.
1965 *Ostrea vesicularis* Cieslinski. *Cenom. Poland*, p. 33, pl. V, fig. 2.

About 50 left valves of medium and large size, imperfectly preserved and fragmentary; one single right valve and two bivalve specimens. Inequilateral left valve, very convex and variable in shape; some specimens are higher, with length/height ratio = 0,72, while on the contrary in some others the height reaches 97% of the length. Margins rather sharp and unundulated, with variable course.

Dorsal surface asymmetrical, falling rather abruptly on the antero-dorsal margin, moderately and uniformly on the postero-dorsal one. Posterior region more or less extended, separated from the rest of the surface by a more or less marked sulcus, sometimes broad and well distinct. Umbo prominent and incurved generally forward. External surface almost smooth, with weak traces of radial ribs only in some specimens; thin concentric growth-lines, unevenly spaced out from one another and concentric folds.

Right valve flat and slightly concave, subtriangular, rounded, thin with maximum thickness in the umbonal region. Dorsal surface undulated; ornaments consisting of thin concentric growth-lamellae, grooves and folds.

Dimensions —	Height	mm	50 (97%);	78 ;	55 (?);	37 ;	90
	Length	mm	56.5 ;	85 (?);	63 (?);	27 (73%);	63 (70%)

Remarks — Many previous authors were doubtful regarding the grouping or separating of *Pycnodonte vesicularis* (Lamarck) and *Pycnodonte vesiculosa* (Sowerby). The policy mainly followed was to leave these two species separate, but some authors (for example Freneix, 1960) grouped them under one species. On the basis of the study of the Afghanistan specimens, the present author decided to follow the opinion of Pervinquière (1912), who considers the two species separately affirming that *P. vesiculosa* (Sowerby) can be distinguished from *P. vesicularis* (Lamarck) by the relatively smaller size, the narrower form near the umbo, the relative thinness of the shell; in both species, the right valve is slightly concave. Pervinquière, followed in this by Parona (1923), adds the fact that *P. vesiculosa* occurring in the Cenomanian could represent the ancestral form of *P. vesicularis* occurring in the Senonian.

One of our specimens differs from the others in form and outline and could be referred to *P. vesicularis similis* Bobkova, 1961 (p. 71, pl. XII, fig. 1 a-b), if it had lacked the rather broad and marked sulcus running from the umbo to the postero-ventral margin, which is not revealed in Bobkova's illustration. For this reason and owing to the lack of sufficient material, I think it could not be considered separately.

The name *Pycnodonta* given by many authors to this genus, is to be considered, according to Vokes (1967, p. 197), as an unnecessary correction of *Pycnodonte*, and thus has to be rejected.

Occurrence — *Pycnodonte vesicularis* (Lamarck) is a cosmopolitan species occurring from the Albian to the Upper Senonian in Europe, Africa, Turkey, India, New Caledon, America, Antarctic. Bobkova records it from the Santonian to the Maastrichtian in the Tajik Depression and in Afghanistan, Rengarten in the Upper Santonian of the Caucasus minor.

Locality — West of Baba Darves (61 AD-30); at 1 km west of Mohammad Aba (61 AD-34); at 2 km west of Mohammad Aba (61 AD-34/1); further north-west of Mohammad Aba (Keshem) (61 AD-29); road junction to Farkhar (61 AE-87/13); west of Baba Darves (61 AD-49); between Darra Sarkhao and Doshi (61 AD-68); at the north-west of Jeldragh (61 AD-37/1); between Aq Bulaq and the road junction to Farkhar (61 AD-54); Farkhar Valley (61 AE-15).

Pycnodonte vesiculosa (Sowerby, 1822)

Pl. 14, fig. 5-7

1822 *Gryphaea vesiculosa* Sowerby. *Mineral-Conch.*, vol. IV, p. 93, pl. CCCLXIX, fig. 1-7.
1869 *Ostrea vesiculosa* Coquand. *Ostrea Terr. Crét.*, p. 152, pl. L, fig. 14, 16; pl. LIX, fig. 4-6.
1868-71 *Ostrea vesiculosa* Pictet and Campiche. *Terr. Crét. Sainte-Croix*, p. 311, pl. 194, fig. 1-6.
1871 *Gryphaea vesiculosa* Stoliczka. *Cret. South. India Pelecyp.*, p. 466, pl. XXXIX, fig. 1, 2.
1882 *Gryphaea vesiculosa* Seguenza. *Cret. Italia Merid.*, p. 182, pl. XIX, fig. 2.
1913 *Ostrea vesiculosa* Woods. *Cret. Lamell. England*, vol. II, p. 374, pl. LV, fig. 10-14; pl. LVI, fig. 1.
1918 *Pycnodonta vesicularis* var. *vesiculosa* Greco. *Fauna Cret. Egitto*, pt. III, p. 13, pl. II, fig. 12 a-b.
1934 *Gryphaea vesiculosa* Blanckenhorn. *Kreideform. Syrien-Palästina*, p. 200, pl. IX, fig. 42, 43.
1937 *Pycnodonta vesicularis* mut. *vesiculosa* Trevisan. *Facies Afric. Sicilia Occ.*, p. 79, pl. II, fig. 15, 16.
1942 *Gryphaea vesiculosa* Stchepinsky. *Faune Crét. Turquie*, p. 58, pl. VI, fig. 4-9.
1963 *Pycnodonta vesiculosa* Fawzi. *Cénom. Egypte*, p. 49 ,pl. V, fig. 1, 2.

About thirty left valves of medium size, incompletely preserved, very heterogeneous. Inequilateral valve, trigonal to ovate, more high than long, with length/height ratio between 0.72 and 0.90. Margins sharp and unundulated; dorsal surface generally asymmetrical, very inclined on the anterior margin, more moderately on the posterior one, where it sometimes extends to form a kind of wing, which can be separated from the rest of the surface by a more or less marked sulcus.

The umbo is massive, in some specimens cannot be easily distinguished from the rest of the valve, while in some others it is thinner and sharper, and not very incurved on the ligamental area. Ornaments of concentric growth-lines, rather regular even though slightly marked, and tumidities.

Dimensions — Height	mm	38;	40;	37.9
Length	mm	32;	38;	29.0

Remarks — In the specimens under consideration, numerous but imperfectly preserved, it is impossible to see the internal cavity, which from Woods' figures seems to be of suboval outline, smooth, regular, with reduced and straight ligamental area and small muscular scar, only slightly emphasized, situated at the mid-dorsal part of the valve. In the paragraph regarding *P. vesicularis* we pointed out the analogies and differences of the latter with the present one, and the relative problems.

Occurrence — *Pycnodonte vesiculosa* (Sowerby) occurs in Upper Cenomanian in Europe (England, Belgium, France, Switzerland, Austria, Italy, Portugal), Tunisia, Syria, Palestine, India, Turkey; in Lower and Upper Cenomanian in Egypt; in Lower Turonian in Afghanistan and Tajik Depression.

Locality — 1 km west of Mohammad Aba (61 AD-34); between Darra Sarkhao and Doshi (61 AD-68).

Subclass PALAEOHETERODONTA

Order TRIGONIOIDA

Superfamily TRIGONIACEA Lamarck, 1819

Family TRIGONIIDAE Lamarck, 1819

Genus **Trigonia** Bruguière, 1789

Trigonia sp. ind.

Some external impressions sufficient for determinating the genus and not the species.

Locality — 2 km west of Mohammad Aba (Keshem). 61 AD-34/1.

Subclass HETERODONTA

Order HIPPURITOIDA

Superfamily HIPPURITACEA Gray, 1848

Family RADIOLITIDAE Gray, 1848

Subfamily RADIOLITINAE Gray, 1848

Genus **Sauvagesia** (Bayle MS) Douvillé, 1886

Sauvagesia sanfilippoi Parona, 1933

Pl. 15, fig. 2

1933 *Sauvagesia sanfilippoi* Parona. *Rudiste Tripolitania*, p. 5, pl. I, fig. 1-3.
1961 *Sauvagesia sanfilippoi* Rossi Ronchetti and Albanesi. *Cenom. Gebel Tripolitano*, p. 292, pl. XXIV, fig. 10, 11 (*cum syn.*).

Ten incomplete left valves, medium in size, subconical, elongate; one single specimen is much broader in proportion to its height.

The ornaments are of straight broad ribs, between which are partially visible weak longitudinal striations, and strong transversal laminae intercalated embricatedly at irregular intervals. The ridges which limit the siphonal bands and the interband are remarkably prominent. Observing a transverse section one can see the two siphonal bands, concave, rather large, separated by a prominent interband but flattened apically, the ligamental ridge short and thin and the structure of the shell, cellular, reticulate bearing large poligonal networks.

Occurrence — *Sauvagesia sanfilippoi* Parona, is recorded by Parona in the Turonian in Tripolitania, and by Rossi Ronchetti and Albanesi in the Cenomanian in Tripolitanian Jebel.

Locality — 2 km west of Mohammad Aba. 61 AD-34/1.

Subfamily LAPEIROUSIINAE Kühn, 1932

Genus **Ichthyosarcolites** Desmarest, 1817

Ichthyosarcolites triangularis Desmarest, 1812

Pl. 15, fig. 1

1812 *Ichthyosarcolites triangularis* Desmarest. *Deux genres foss.*, p. 324.
1887 *Ichthyosarcolites triangularis* Douvillé. *Famille Chamidés*, p. 791, text-fig. 15-17.
1961 *Ichthyosarcolites triangularis* Rossi Ronchetti and Albanesi. *Cenom. Gebel Tripolitano*, p. 290 (*cum syn.*).

A single small left valve incompletely preserved as an internal mould. Valve rather elongate with a diameter about 45.5 mm, coiled in an open spiral, with a characteristic arch-like circle. Only half of a spiral whorl is preserved; the section at the beginning triangular, becoming subtriangular ventrally. Along the flanks one can observe numerous grooves, swellings, and longitudinal striations extenuating towards the apex of the valve.

Occurrence — *Ichthyosarcolites triangularis* Desmarest has been recorded in the Cenomanian in France, Istria, Bulgaria, Tripolitania, Tunisia, North Africa in general.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Ichthyosarcolites tricarinatus Parona, 1921

1921 *Ichthyosarcolites tricarinatus* Parona. *Neocret. Tripolitania*, pt. I, p. 13, pl. II (V), fig. 2.
1961 *Ichthyosarcolites* cf. *tricarinatus* Rossi Ronchetti and Albanesi.. *Cenom. Gebel Tripolitano*, p. 291 (*cum syn.*).
1961 *Ichthyosarcolites tricarinatus* Bobkova. *Lamell. Upper Cret.*, p. 180, pl. XXXI, fig. 1 a-e.

Two medium-sized internal moulds of left valve, not very well preserved. Valve tubular elongate, subprismatic, arched, tending to coil slightly along the length, and having a quadrangular section near the aperture. Surface crossed by three longitudinal folds, of which the posterior one is very developed, whilst the median and the anterior are weakly prominent; the folds are separated by three longitudinal grooves. Ornaments of broad ribs running across the shell along the length, separated by shallow furrows, especially visible along the flanks.

Remarks — The species under examination is easily distinguished from *Ichthyosarcolites triangularis* Desmarest, found also in the material under study; in fact, in the latter the left valve is spirally coiled and the section is triangular near the aperture; in addition the three folds are lacking. The surface of the specimen is slightly worn but shows rather clearly the characteristic structure which the author of the species calls « with canaliculi ».

Occurrence — *Ichthyosarcolites tricarinatus* Parona occurs in the Upper Cenomanian in Tripolitania, and mount Gargano.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Order VENEROIDA

Suborder LUCININA

Superfamily CARDITACEA Fleming, 1820

Family CARDITIDAE Fleming, 1820

Subfamily CARDITINAE Fleming, 1820

Genus **Cardita Bruguière, 1792**

Cardita nicaisei Coquand, 1862

Pl. 15, fig. 5

1862 *Cardita nicaisei* Coquand. *Constantine*, p. 200, pl. XIV, fig. 16, 17.
1912 *Cardita nicaisei* Pervinquière. *Etudes Paléont. Tunisienne*, p. 240, pl. 17, fig. 13-17.
1963 *Cardita nicaisei* Fawzi. *Faune Cénom. Egypte*, p. 63.

Two internal moulds and four external impressions, more or less incomplete, and small-sized. Valve inequilateral, triangular-ovate, more long than high, with height/length ratio = 0.70, not very convex, with regular convexity. Anterior margin straight, oblique, forming almost a right angle with the ventral margin; posterior margin in the dorsal part slightly convex, then oblique, longer than the anterior one, forming an acute angle with the ventral, faintly curvilinear.

Dorsal surface posteriorly more extended than anteriorly, and with a postero-ventral extremity which tapers. In two specimens a faint carina is visible, running from the umbo to the postero-ventral corner. Umbo incurved, prominent, sharp, placed slightly anteriorly. Ornaments comprising 16 granular, and well marked radial ribs, separated by rather large furrows, whose width is almost twice that of the ribs in correspondence to the ventral margin, which is denticulated by the ribs. Closer ribs in the posterior region, where they are oblique, more spaced out in the anterior region, where they are decidly inclined forward.

Dimensions — Height mm 17 (70%)
Length mm 24

Remarks — The specimens under consideration resemble in ornaments the young specimens cf. *C. beaumonti* d'Archiac; however they differ in the more oval outline, in the untruncated posterior region, and in the minor convexity of the valve. This species has also been recorded in more recent horizons of the Cretaceous (Maastrichtian).

Occurrence — *Cardita nicaisei* Coquand occurs in the Cenomanian in Tunisia, Egypt, and in Upper Cenomanian in Syria, Palestine and Algeria.

Locality — Between Darra Sarkhao and Doshi. 61 AD-68.

Suborder Venerina

Superfamily Arcticacea Newton, 1891

Family Arcticidae Newton, 1891

Genus Arctica Schumacher, 1817

(= *Cyprina* Lamarck, 1818 vulg. nom.)

Arctica calabra (Seguenza, 1876)

Pl. 15, fig. 3

1876 *Cyprina calabra* Seguenza. *Cenom. Caltavuturo*, p. 2.
1882 *Cyprina calabra* Seguenza. *Cret. Italia Merid.*, p. 138, pl. VIII, fig. 2 a-b.
1937 *Cyprina calabra* Trevisan. *Cenom. Sicilia Occ.*, p. 89, pl. VI, fig. 9 a-b, 10, 11.
1948 *Cyprina calabra* Tavani. *Cret. Somalia e Ogaden*, p. 122, pl. VII, fig. 17.

A single internal mould of right valve, medium in size, rather imperfectly preserved. Inequilateral valve, with subtrapezoidal-oval outline, more long than high, with height/length ratio = 0.75, moderately convex, with maximum convexity in the medio-dorsal region. As far as one can see the anterior margin is sunken under the umbo, then convex; posterior margin long and oblique, ventral margin slightly curved. Dorsal surface medianly swollen, forming almost a carina which runs from the umbo to the postero-ventral corner, separating a more restricted anterior side from a more developed posterior side. Umbo faintly prominent, strong, prosogyre, placed at the anterior one-third of the valve. Area und lunula not visible.

Dimensions —	Height	mm 33 (75%)
	Length	mm 44

Remarks — The author of the species distinguishes two varieties of *Cyprina calabra*, varieties A and B; the specimen under study is more similar to var. B, in the convexity weakly marked, in the carina and the slightly prominent umbo.

Occurrence — *Arctica calabra* (Seguenza) is recorded in the Cenomanian in Calabria (Italy), Somalia, Ogaden; in the Cenomanian of « African facies » in western Sicily and southern Italy.

Locality — West of Baba Darves. 61 AD-30 (not in situ).

Arctica sp. ind.

Pl. 15, fig. 4

A single internal bivalve mould well preserved, large, very thick, especially in the postero-dorsal region (thickness about 77% of the height). Inequilateral shell, with subtrigonal outline, convex at the postero-umbonal region, very extended towards the ventral margin, much more long than high, with height/length ratio of about 0.87. Anterior margin sunken under the umbo, becoming later oblique to meet the ventral margin forming a broad arch; posterior margin convex, extending to about 64% the total height of the valve, and passing gradually to the ventral margin, almost straight.

Dorsal surface asymmetrical, extending anteriorly in the shape of a wing, limited dorsally by the muscular scar. Umbones situated at about anterior third of the length, slightly inclined forward, convex, prominent, with separate beaks. Lunula elongate, area rather short and broad. Surface smooth; pallial line invisible; muscular scars faintly marked.

Dimensions —	Length	mm 54
	Height	mm 47 (87%)
	Thickness	mm 36.4 (67%)

Remarks — The specimen under consideration is rather similar to *Aphrodina plana* (Sowerby), but differs in the remarkable thickness and the convex and prominent umbones. The specimens of *A. plana* figured by Blanckenhorn (1934) is also remarkably thick (Th = 41 mm, H = 55 mm, L = 66 mm), but its umbones are situated more anteriorly. As only a single internal mould is at my disposal, I think it is hardly the case to establish a new species.

Locality — 3 km east of Aq Bulaq. 61 AE-69.

Genus **Veniella** Stoliczka, 1870

Veniella sp. ind.

Pl. 15, fig. 8

A single big bivalve specimen, compressed antero-posteriorly, not very well preserved, where only the posterior region is visible. Shell equivalve and inequilateral, heart-shaped, massive, more high than long, showing the typical aspect of the genus *Veniella*, in the form of *Trigonia* compressed, and in the umbo-ventral carina accentuated by a sulcus running parallel and posterior to it. Posterior area with a feeble, short, curved rib at the umbonal region. Umbo very incurved, convex and prominent, with sharp beaks, very spaced out from one another. Ornaments not visible.

Remarks — The specimen resembles *Veniella cordialis* (Forbes) figured by Dartevelle and Freneix (1957, pl. 23, fig. 8), in the outline, the strong thickness, the umbones convex, incurved, and in the separated beaks. But the deformations which it presents, its incomplete preservation, and consequently the lack in ornaments do not permit its identification with this species nor to any other one of the genus *Veniella*.

Locality — Between Darra Sarkhao and Doshi. 61 AD-68.

Superfamily VENERACEA Rafinesque, 1815

Family VENERIDAE Rafinesque, 1815

Subfamily MERETRICINAE Fischer, 1887

Genus **Aphrodina** Conrad, 1869

Aphrodina plana (Sowerby, 1813)

Pl. 15, fig. 6

1813 *Venus plana* Sowerby. *Mineral-Conch.*, vol. I, p. 58, pl. XX, fig. 2, 3.
1870 *Cytherea plana* Stoliczka. *Cret. South. India*, vol. III, p. 69, pl. VII, fig. 1-4.
1908 *Callista plana* Woods. *Cret. Lamell. England*, vol. II, p. 192, pl. XXX, fig. 1-6.
1934 *Cytherea plana* Blanckenhorn. *Kreideform. Syrien-Palästina*, p. 254, pl. XIV, fig. 158.
1937 *Cytherea plana* Trevisan. *Cenom. Sicilia Occ.*, p. 108, pl. VII, fig. 20-22.
1943 *Cytherea* cf. *plana* Van der Weijden. *Kreide Berücksicht. Lamell.*, p. 59, pl. IV, fig. 10, 11.
1961 *Aphrodina plana* Rossi Ronchetti. *Foss. Cret. Pull-i-Khumri*, p. 355, pl. XXVIII, fig. 1, 2.

An internal mould of left valve rather well preserved, medium in size and a fragment. Slightly inequilateral valve, with a subtriangular outline, extended ventrally, more long than high, with height/length ratio of about 0.85, faintly and regularly convex, thickness reaching about 35% of the height. Antero-dorsal margin sunken under the umbo, then oblique and meeting the ventral forming a broad arch; postero-dorsal margin slightly convex and ventral margin weakly curved. Umbo prosogyre, placed just anterior to mid-length, flat, with sharp beaks. External surface granular and worn away. Internal surface not visible.

Dimensions —	Length	mm 47
	Height	mm 40 (85%)
	Thickness	mm 14

Remarks — The specimen under consideration is similar in outline to the illustration of the species given by Rossi Ronchetti (1961, pl. XXVIII, fig. 1) and also in size, except for the height which is inferior in the specimen of Pull-i-Khumri.

In the material under study we find a specimen signed with 61 AD-30 (33 mm high and 45 mm long), imperfectly preserved, which seems to be doubtingly attributable to the specie of Sowerby (pl. 15, fig. 7).

Occurrence — *Aphrodina plana* (Sowerby) occurs from the Aptian to the Upper Senonian in Europe, Northern Africa, Cameroun, Syria and Palestine, Southern India, Afghanistan.

Locality — 2 km west of Mohammad Aba (61 AD-34/1); west of Baba Darves (61 AD-30).

Class Gastropoda

Subclass Prosobranchia

Order Archaeogastropoda

Superfamily Pleurotomariacea Swainson, 1840

Family Pleurotomariidae Swainson, 1840

Genus **Pleurotomaria** Defrance, 1826

Pleurotomaria sp. ind.

Pl. 15, fig. 12

A single globular specimen incompletely preserved.

Locality — 2 km west of Mohammad Aba. 61 AD-34/1.

Order Mesogastropoda

Superfamily Cerithiacea Fleming, 1822

Family Turritellidae Woodward, 1851

Genus **Haustator** Monfort, 1810

Haustator multiplicatus Pcelincev, 1954

Pl. 15, fig. 9, 10

1954 *Haustator multiplicatus* Pcelincev. *Gastér. Crét. Sup.*, p. 50, pl. I, fig. 14-18.

Three small internal moulds imperfectly preserved, turriculate; whorls moderately convex, separated by deep sutures. Ornaments consisting of 4 spiral cords, of which two are faintly visible.

Occurrence — *Haustator multiplicatus* Pcelincev is recorded in the Cenomanian in Transcaucasia.

Locality — 2 km west of Mohammad Aba. 61 AD-34/1.

Order Neogastropoda

Family Actaeonellidae Pcelincev, 1953

Genus **Trochactaeon** Meek, 1863

Trochactaeon matensis (Fittipaldi, 1900)

Pl. 15, fig. 11

1900 *Actaeonella matensis* Fittipaldi. *Gastr. Turon.*, p. 11, pl. I, fig. 14.
1953 *Trochactaeon matensis* Pcelincev. *Gastér. Crét. Sup. Asie Centr.*, p. 442, pl. L, fig. 8-11; pl. LI, fig. 8-12.

A single internal mould, of which only the two last whorls are preserved, with a sutural ramp reaching one-third the height of the whorl. Last whorl subcylindrical, with elongate peristoma, narrow adapically, broadened abapically.

Occurrence — *Trochactaeon matensis* (Fittipaldi) is recorded in the Turonian in Italy and in the Lower Turonian in Transcaucasia.

Locality — 2 km west of Mohammad Aba. 61 AD-34/1.

Class Cephalopoda

Order Ammonoidea

Suborder Ammonitina

Family Vascoceratidae Spath, 1925

Genus **Thomasites** Pervinquière, 1907

Thomasites sp. ind.

Pl. 16, fig. 1

A single specimen of moderate size, incompletely preserved, which does not permit a specific identification. Shell very involute with subelliptical whorl section, narrowed ventrally; venter very convex; whorl side slightly arched; umbilicus not visible. Ornaments of strong ribs ending with faintly distinct ventro-lateral tubercles; venter with a spiral row of strong and slightly elongate tubercles.

Occurrence — The genus *Thomasites* is recorded in Northern Africa, in Syria and Texas in the Lower Turonian.

Locality — At the road junction to Farkhar. 61 AD-87/13.

Selected Bibliography

Abbas H. L., 1962 — *A Monograph on the Egyptian Cretaceous Pelecypods*. Geol. Surv. Min. Res. Depart., Palaeont. series, Mon. n. 1, pp. XII + 224, 24 pl., 1 fig., Cairo.

Andert H., 1934 — *Die Kreideablagerungen zwischen Elbe und Ieschken*. T. III. *Die Fauna der obersten Kreide in Sachsen, Böhmen und Schlesien*. Abh. Preuss. Geol. Landesanst., N.F., H. 159, 477 pp., 19 pl., 93 fig., Berlin.

Baroni C., Incitti L., Oliveri A., Viola V., 1954 — *Revisione della fauna Neocretacea della Libia: fam. Pinnidae, Mytilidae, Limidae, Nuculidae, Ledidae, Arcidae, Cyprinidae, Astartidae, Crassatellidae, Veneridae, Cardiidae, Lucinidae, Aloididae, Thraciidae, Chamidae*. Ann. Mus. Libico St. Nat., v. IV, pp. 11-109, 6 pl., Roma.

Bion H. S., Coggin-Brown J., 1925 — *Notes on Cretaceous Fossils from Afghanistan and Khorasan*. Rec. Geol. Surv. India, vol. LVI, pt. 3, pp. 257-269, Calcutta.

Blanckenhorn M., 1934 — *Die Bivalven der Kreideformation von Syrien-Palästina*. Palaeontographica, Bd. 81, pp. 161-296, 8 pl., 2 fig., Stuttgart.

Bobkova N. N., 1959 — *Deposits of Cretaceous in the Tajikistan south-eastern*. Geol. SSSR, t. 24, RRS Tajikistan, pp. 269-285, Moskva.

Bobkova N. N., 1961 — *Upper Cretaceous Ostreids from Tajik Depression*. Problems of the petroleum research in Central Asia. N. 7. Tr. VSEGEI, n. s., t. 50, 140 pp., 32 pl., Leningrad. (In russian).

Bobkova N. N., 1961 — *Stratigraphy and Mollusca Lamellibranchiata of the Upper Cretaceous in Tajik Depression*. Problems of the petroleum research in Central Asia. N. 8. Tr. VSEGEI, n. s., t. 54, 189 pp., 31 pl., 13 fig., Leningrad. (In russian).

BÖHM J., 1899 — *Ueber einige Fossilien aus Buchara*. Zeit. Deut. Geol. Ges., Bd. 51, H. 3, pp. 465-470, 2 pl., Berlin.

BÖHM J., 1903 — *Ueber cretaceische und eocäne Versteinerungen aus Ferghana*. In FUTTERER K., *Durch Asien*, Bd. III, Lief. 1, pp. 95-111, 1 pl., Berlin.

BRUN (DE) P., CHATELET C., 1926 — *Le Cénomanien de Montfaucon*. Trav. Lab. Géol. Fac. Sc. Lyon, fasc. IX, Mém. 8, 75 pp., 2 pl., 30 fig., Lyon.

BUCH (VON) L., in BEYRICH E., 1852 — *Bericht über die von Overweg auf der Reise von Tripoli nach Murzuck und von Murzuck nach Ghat gefundenen Versteinerungen*. Monatsb. Verhandl. Ges. Erdkunde Berlin, N.F., Bd. IX, 156 pp., 6 pl., Berlin.

CIESLINSKI S., 1965 — *Stratigraphy and fauna of the Cenomanian in Poland (excluding the Carpathians and Silesia)*. Inst. Geol. Bull., n. 192, pp. 5-55, 6 pl., Warszawa.

COLLIGNON M., 1934 — *Fossiles turoniens d'Antantiloky*. Gouvern. Gén. Madagascar Dépendences, Ann. Géol. Serv. Mines, fasc. IV, 59 pp., 6 pl., Tananarive.

COLLIGNON M., 1949 — *Recherches sur les faunes albiennes de Madagascar*. Pt. I. *La faune albienne d'Ambarimaninga*. Ann. Géol. Serv. Mines, fasc. XVI, 128 pp., 22 pl., Paris.

COQUAND M. H., 1862 — *Géologie et Paléontologie de la région sud de la Province de Constantine*. Mém. Soc. Emulation Provence, t. II, pp. 5-341, 35 pl., Marseille.

COQUAND M. H., 1869 — *Monographie du genre Ostrea. Terrain Crétacé*. 215 pp., 75 pl., Paris.

COTTREAU J., 1922 — *Paléontologie de Madagascar*. Pt. X. *Fossiles crétacés de la côte orientale de Madagascar*. Ann. Paléont., t. XI, pp. 111-192, 11 pl., Paris.

COX L. R., 1940 — *Cretaceous Mollusca described by Pulteney in the second edition of Hutchin's history of Dorset*. Proc. Malacol. Soc., vol. 24, pt. 3, pp. 121-128, 7 pl., London.

COX L. R., 1952 — *Cretaceous and Eocene Fossils from Gold Coast*. Gold Coast Geol. Surv. Bull., vol. 17, 68 pp., 5 pl., Cardiff.

COX L. R., 1960 — *Thoughts on the Classification of the Bivalvia*. Proc. Malacol. Soc., vol. 34, pt. 2, pp. 60-88, 2 fig., London.

DARTEVELLE E., FRENEIX S., 1957 — *Mollusques fossiles du Crétacé de la Côte occidentale d'Afrique, du Cameroun à l'Angola*. Pt. II. *Lamellibranches*. Ann. Mus. R. Congo Belge, Sc. Géol., vol. 20, pp. VIII + 271, 35 pl., Tervuren.

DESIO A., 1960 — *Ricognizioni geologiche nell'Afghanistan*. Boll. Soc. Geol. Ital., vol. LXXXIX, fasc. 3, pp. 99-179, 19 fig., Roma.

DESIO A., MARTINA E., PASQUARÉ G., 1964 — *On the geology of central Badakhshan*. Quart. Journ. Geol. Soc., vol. 120, pp. 127-151, 3 fig., London.

DESMAREST A. G., 1812 — *Mémoire sur deux genres de coquilles fossiles cloisonnées a siphon*. Bull. Soc. Phys. Médic. Agricolt., n. 5, pp. 308-324, Orléans.

D'ORBIGNY A., 1843-1847 — *Paléontologie française. Terrains Crétacés*. T. III. *Lamellibranches*. 807 pp., 489 pl., Ed. Masson, Paris.

D'ORBIGNY A., 1847-1849 — *Paléontologie française. Terrains Crétacés*. T. IV *Brachiopodes*. 390 pp., 599 pl., Ed. Masson, Paris.

D'ORBIGNY A., 1850 — *Prodrome de Paléontologie stratigraphique universelle des animaux mollusques et rayonnées fossiles*. Vol. II, 427 pp., Ed. Masson, Paris.

DOUVILLÉ H., 1887 — *Sur quelques formes peu connues de la famille des Chamidés*. Bull. Soc. Géol. France. t. XV. s. 3, pp. 756-802, 4 pl., 19 fig., Paris.

DOUVILLÉ H., 1926 — *Description de quelques fossiles crétacés de l'Afghanistan*. Rec. Geol. Surv. India, vol. LVIII, pt. 4, pp. 345-348, 12 pl., 2 fig., Calcutta.

DUJARDIN F., 1837 — *Les couches du sol en Touraine*. Mém. Soc. Géol. France., t. 2, pt. 20, pp. 211-308, 6 pl., Paris.

FAWZI M. E. A., 1963 — *La faune Cénomanienne d'Egypte*. Géol. Surv. Min. Res. Depart., Palaeontol. Series, Mon. n. 2, 133 pp., 8 pl., Alexandrie.

FITTIPALDI E. V., 1900 — *Gastropodi del calcare turoniano di S. Palo Matese* (*Campobasso*). Atti R. Acc. Sc. Fis. Mat. Napoli, vol. X, ser. 2, n. 5, 13 pp., 1 pl., Napoli.

FORBES E., 1846-1847 — *Report on the fossil Invertebrata from Southern India collected by M. Kaye and Cunliffe*. Trans. Geol. Soc., vol. VII, pp. 97-174, 13 pl., London.

FOURTAU R., 1917 — *Catalogue des Invertébrés fossiles de l'Egypte. Terrains crétacés*. Pt. II. *Mollusques Lamellibranches*. Géol. Surv. Egypte, Palaeont. ser., n. 3, pp. VIII + 109, 7 pl., Cairo.

FRENEIX S., 1959 — *Mollusques fossiles du Crétacé de la Côte occidentale d'Afrique, du Cameroun à l'Angola*. Pt. III. *Conclusion stratigrafiques et paléontologiques*. Ann. Mus. R. Congo Belge, Sc. Géol., vol. 24, pp. XV + 126, 5 pl., 15 fig., Tervuren.

FRENEIX S., 1960 — *Etude complémentaire des Lamellibranches du Crétacé de Nouvelle Calédonie*. Sc. de la terre, t. IV, n. 1-2, pp. 5-56, 3 pl., 1 fig., Nancy.

GOLDFUSS A., 1833-1840 — *Petrafacta Germaniae*. T. II, pp. 1-312, 93 pl., Berlin.

GRECO B., 1917-1918 — *Fauna cretacea dell'Egitto raccolta dal Figari Bey*. Pt. III. *Lamellibranchiata*. Fasc. 1. Palaeont. Ital., vol. XXIII (1917), pp. 93-161, 5 pl.; fasc. 2. Ibidem, vol. XXIV, (1918), pp. 1-58, 5 pl., Pisa.

HENRIQUES DA SILVA G., 1963 — *Lamellibrânquias de Cretácico da regiao Carunjamba-Salinas-S. Nicolau* (*Angola*). Bol. Serv. Geol. Minas Angola, 2 sem., pp. 5-67, 10 pl., Luanda.

HINZE C., 1964 — *Die geologische Entwicklung der östlichen Hindukush-Nord flanke* (*Nordost-Afghanistan*). Beihefte Geol. Jahrb., H. 70, pp. 19-75, 2 pl., Hannover.

KAEVER M., 1963 — *Das Hadjar-Kreide Tertiär-Profil und seine Stellung in der Ober-Kreide Zentral-Afghanistan*. N. Jh. Geol. Paläont., pp. 669-677, Stuttgart.

KAEVER M., 1968 — *Die Kreide Afghanistan*. Zentralbl. Geol. Paläont., Teil 1, H. 10, Jahr. 1967, pp. 1853-1880, Stuttgart.

KUHN O., 1932 — *Rudistae*. Fossilium Catalogus, t. I, Animalia, pt. 54, 200 pp., Berlin.

ICZN, 1964 — *International code of zoological nomenclature adopted by the XV international Congress of Zoology*, 176 pp., Intern. trust for zool. nomenclature, London.

LAMARCK J. B., 1806-1809 — *Mémoire sur les fossiles des environs de Paris*. Ann. Mus. Hist. Nat., vol. VIII, vol. XIV, Paris.

LAMARCK J. B., 1819-1838 — *Histoire naturelle des animaux sans vertèbres. Lamellibranches*, vol. VI (1819), 600 pp.; vol. VII (1838), 735 pp., Paris.

LAPPARENT A. F. DE, DE LAVIGNE SAINTE SUZANNE J., 1964 — *Le Crétacé marin à Saïghan et à l'Ouest de l'Hindou Kouch* (*Afghanistan*). Ann. Soc. Géol. Nord, t. LXXXIV, n. 1, pp. 249-252, 1 pl., 1 fig., Lille.

MATHERON P., 1842 — *Catalogue métodique et descriptif des corps organisés fossiles du département des Bouches-du Rhône et lieux circonvoisins*. Rép. Trav. Soc. Statistique, t. 6, 240 pp., 41 pl., Marseille.

MAXIA C., 1940 — *Illustrazione di alcuni Pettinidi Maestrichtiani della Tripolitania*. Boll. Soc. Geol. Italia, vol. LIX, fasc. I, 10 pp., 1 pl., Roma.

MAXIA C., 1940 — *Ostreidi neocretacee della Tripolitania*. Boll. Soc. Geol. Italia, vol. LIX, fasc. II, pp. 136-163, 4 pl., Roma.

MENESSIER G., 1962 — *Sur la stratigraphie du Crétacé dans le Turkestan afghan*. Ann. Soc. Géol. Nord, t. LXXXII, n. 1, pp. 19-25, 2 fig., Lille.

MIRKAMALOV K. K., 1964 — *The systematic position of Amphidonta*. Paleont. Zhurn., n. 2, pp. 149-152, 1 pl., Moskva. (In russian).

MOORE R. C., 1965 — (Edit.) *Treatise on Invertebrate Paleontology*. Part. H. *Brachiopoda*, 2 vol. Geol. Soc. Amer., Univ. Kansas Press, 927 pp., 746 fig., Lawrence, Kansas.

MUROMZIEVA T. L., 1960 — In Red. DRUSHCHIZA V. V., KUDRJAVZEVA M. P., *Atlas of the Lower Cretaceous fauna from Northern Caucasus and Crimea. Taxodonte*. Tr. VNIIGaz, pp. 172-204, 2 pl., Moskva.

NEWTON B. R., 1915-1916 — *On some Cretaceous Brachiopoda and Mollusca from Angola. Portuguese West Africa*. Trans. R. Soc., vol. LI, pt. III, pp. 561-580, 2 pl., Edinburgh.

PARONA C. F., 1921 — *Fauna del Neocretaceo della Tripolitania. Molluschi*. Pt. I, *Lamellibranchi* (*Rudiste*). Mem. Descr. Carta Geol. Italia, vol. VIII, 21 pp., 3 pl., 16 fig., Roma.

PARONA C. F., 1923 — *Fauna del Neocretaceo della Tripolitania. Molluschi*. Pt. II. *Lamellibranchi*. Mem. Descr. Carta Geol. Italia, vol. VIII, pt. 4, 52 pp., 6 pl., Roma.

PARONA C. F., 1928 — *Faune Cretaciche del Caracorum e degli altipiani Tibetani*. Sped. Ital. De Filippi (1913-14), s. II, vol. VI, pp. 104-147, 5 pl., Bologna.

PARONA C. F., 1933 — *Di alcune Rudiste della Tripolitania*. Boll. Uff. Geol. Italia, vol. LVIII (1932), n. 2, pp. 1-8, 1 pl., 1 fig., Roma.

PCELINCEV V. F., 1953 — *Faunes de Gastéropodes du Crétacé supérieur de Transcaucasie et d'Asie Centrale*. Izd. Ak. Nauk USSR, 561 pp., 51 pl., 47 fig., Moskva. (Trad. C.N.D.S., n. 2210).

PCELINCEV V. F., 1954 — *Gastéropodes du Crétacé supérieur de la R.S.S. d'Arménie et de la partie adjacente de la R.S.S. d'Azerbaidjan*. Izv. Ak. Nauk USSR, 178 pp., 23 pl., 52 fig., Moskva. (Trad. C.N.D.S., n. 2383).

PERVINQUIÈRE L., 1903 — *Etude géologique de la Tunisie centrale*. Carte Géol. Tunisie, pp. VII + 359, 3 pl., 42 fig., Paris.

PERVINQUIÈRE L., 1912 — *Etude de Paléontologie tunisienne*. Pt. II. *Gastropodes et Lamellibranches*. Carte Géol. Tunisie, 352 pp., 23 pl., 17 fig., Paris.

PICTET F. J., CAMPICHE G., 1868-1871 — *Description des fossiles du terrain crétacé des environs de Sainte Croix*. Mater. Paléont. Suisse, pt. IV, 352 pp., 55 pl., Genève.

POPOL S. A., TROMP S. W., 1954 — *The stratigraphy and main structural features of Afghanistan*. K. Nederl. Akad. Wetens., s. B, vol. 57, n. 3, pp. 370-394, 3 pl., Amsterdam.

PULTENEY R., 1813 — *Catalogues of the Birds, shells and some of the more rare Plants of Dorsetshire*. Vol. of VIII + 110 pp., 23 + 1 pl. (fossils). Libr. Linnean Soc., London.

PUSH G. G., 1837 — *Polens Paläontologie oder Abbildung und Beschreibung*. Vol. of XIII + 218 pp., 16 pl., Stuttgart.

RENGARTEN V. P., 1964 — *Representatives of Ostreidae Family in the Cretaceous deposits of Caucasus Minor*. Ak. Nauk USSR, vyp. 96, 87 pp., 10 pl., Moskva. (In russian).

ROSSI C., 1943 — *Revisione e critica della Exogyra overwegi von Buch* (*Maestrichtiano*). Riv. Ital. Paleont., vol. 49, 22 pp., 1 pl., 1 fig., Milano.

ROSSI RONCHETTI C., 1954 — *Revisione della fauna neocretacica della Libia: Fam. Ostreidae*. Ann. Mus. Libico St. Nat., vol. IV, 59 pp., 3 pl., Roma.

ROSSI RONCHETTI C., 1961 — *Fossili cretacei di Pull-i-Khumri* (*Afghanistan*). Riv. Ital. Paleont. Strat., vol. LXVII, n. 4, pp. 341-368, 3 pl., Milano.

ROSSI RONCHETTI C., 1962 — *Variazioni e accrescimento relativo in Exogyra overwegi von Buch del Maestrichtiano Libico*. Riv. Ital. Paleont. Strat., vol. LXVIII, n. 2, pp. 193-252, 5 pl., 29 fig., Milano.

ROSSI RONCHETTI C., ALBANESI C., 1961 — *Fossili cenomaniani del Gebel Tripolitano.* Riv. Ital. Paleont. Strat., vol. LXVII, n. 3, pp. 251-318, 6 pl., Milano.

RUSSO A., 1958 — *I Lamellibranchi delle marne cenomaniane « in Facies africana » della zona di Barcellona in Sicilia.* Mem. Ist. Geol. Univ. Padova, vol. XX, 26 pp., 5 pl., Padova.

SAHNI M. R., 1960 — *Revision of the Cretaceous Terebratulidae of Southern India with descriptions of two species from the east Coast Gondwana.* Palaeont. Indica, n.s., vol. XXXV, Mem. n. 1, 33 pp., 5 pl., Calcutta.

SALVAN H., 1954 — *Les Invertébrés fossiles des phosphates marocains.* T. II. *Paléontologie.* Notes Mém. Géol. Maroc, n. 93, 257 pp., 18 pl., 82 fig., Paris.

SEGUENZA G., 1876 — *I fossili del Cenomaniano di Caltavuturo, nella provincia di Palermo.* (elenco). Rend. R. Acc. Sc. Fis. Mat., fasc. I, Napoli.

SEGUENZA G., 1882 — *Studi geologici e paleontologici sul Cretaceo medio dell'Italia meridionale.* Atti R. Acc. Lincei, anno CCLXXIX, s. III, vol. XII, pp. 62-214, 21 pl., Roma.

SOARES A. F., 1961 — *Lamellibrânquios do Cretacico da regiao de Benguela-Cuio (Angola).* Serv. Geol. Minas Angola, Bol. n. 4, pp. 5-62, 14 pl., 7 fig., Luanda.

SOWERBY J., 1812-1846 — *The Mineral-Conchology of Great Britain.* 7 vol., 1295 pp., 648 pl., London.

STCHEPINSKY V., 1942 — *Contribution à l'étude de la faune crétacée de la Turquie.* Meteae, Mad. Teck. Arama Enst., s. B, Mem. n. 7, 68 pp., 7 pl., Ankara.

STCHEPINSKY V., 1946 — *Fossiles caractéristiques de Turquie.* Inst. Et. Rech. Min. Turquie, Carte géol. n. 1, 149 pp., 37 pl., Ankara.

STOLICZKA F., 1870-1871 — *Cretaceous Fauna of Southern India. The Pelecypoda.* Palaeont. Indica, s. VI, vol. III, 537 pp., 50 pl., Calcutta.

STOLICZKA F., 1872 — *Cretaceous Fauna of Southern India. The Brachiopoda.* Palaeont. Indica, s. VIII, vol. IV, 31 pp., 7 pl., Calcutta.

TAVANI G., 1939 — *Fossili cretacei dello Zululand.* Atti Soc. Toscana Sc. Nat., vol. 48, pp. 3-24, 2 pl., Pisa.

TAVANI G., 1942 — *Molluschi del Cretaceo della Somalia.* Palaeont. Ital., vol. XXXII, (suppl. 4, fasc. 2), pp. 7-47 (93-133), 4 pl., 3 fig., Pisa.

TAVANI G., 1948 — *Fauna malacologica cretacea della Somalia e dell'Ogaden.* Pt. I, *Lamellibranchiata.* Palaeont. Ital., vol. XLIII, (n.s., vol. XIII, 1947), pp. 83-154, 11 pl., Pisa.

TREVISAN L., 1937 — *La fauna ed i giacimenti del Cenomaniano di facies africana della Sicilia occidentale.* Mem. Ist. Geol. Univ. Padova, vol. XII, 134 pp., 7 pl., 10 fig., Padova.

VAN DER WEIJDEN W. J. M., 1943 — *Die Macrofauna der hervenschen Kreide mit besonderer Berücksichtigung der Lamellibranchiaten.* Meded. Geol. Sticht., s. C-IV-2, n. 1, 139 pp., 15 pl., 3 fig., Maastricht.

VOKES H. E., 1967 — *Genera of the Bivalvia: A systematic and bibliographic catalogue.* Bull. Amer. Paleont., vol. 51, n. 232, pp. 111-394, Ithaca, New York.

WENZ W., 1938-1944 (rev. 1960-62) — *Gastropoda.* Teil 1. *Allgemeiner Teil und Prosobranchia.* Handb. Palaeozool., vol. 6, 1639 pp., 4211 fig., Berlin.

WOODS H., 1899-1913 — *A monograph of the Cretaceous Lamellibranchiata of England.* Palaeont. Soc., vol. I (1899-1903), 232 pp., 42 pl., 7 fig.; vol. II (1904-1913), 473 pp., 62 pl., 252 fig., London.

WOODS H., 1906 — *The Cretaceous Fauna of Pondoland.* Ann. South African Mus., vol. 4, pt. 7, pp. 275-350, 12 pl., London.

YABE Y., 1959 — *Some Cretaceous Pelecypods from Afghanistan.* Bull. Geol. Surv. Japan, vol. 10, n. 4, pp. 287-295, 4 pl., 1 fig., Kawasakishi.

CRETACEOUS - EOCENE MICROFAUNAS OF WESTERN BADAKHSHAN AND KATAGHAN (NORTH-EASTERN AFGHANISTAN)

by

ISABELLA PREMOLI SILVA

Assistant at the Institute of Paleontology of the Milan University

Introduction

This work relates to the systematic documentation of the microfaunas present in numerous Cretaceous-Eocene sections in Western Badakhshan, which were investigated by the 1961 expedition directed by Prof. A. Desio.

The presence of characteristic microfossils allowed a biostratigraphical subdivision which is the subject of another report, prepared in collaboration with M.B. Cita as an appendix to the volume on the Geology of Afghanistan and at present in press. Information relating to purely geological and biostratigraphical characters in dealt with in the afore mentioned reports.

The available literature concerning the considered area is very poor, particularly in terms of Foraminifera.

De Cizancourt (1936) describes *Orbitocyclina minima* (Douvillé) in Upper Cretaceous limestone at Taliqan (North-East Afghanistan).

Cita and Ruscelli (1959) figure a *Cuneolina* and *Dicyclina* bearing level in the Pull-i-Khumri section (NE Afghanistan) of Cenomanian and/or Turonian age.

De Lapparent (1963) finds *Orbitoides* and *Siderolites* in marly, fossiliferous limestones from Kahmard Valley, and Kaever (1965 b) gives lists of microfossils from near Ali Abad, where one of the sections here considered has been measured.

Other papers to be listed here and which were of particular interest, are those by Bykova (1953, 1959), by Gekker, Osipova and Belskaya (1962), by Davidson and Morozova (1964), by Morozova, Kreidenkov and Davidson (1965). Useful data on the distribution of planktonic and benthonic Foraminifera may be found in them, concerning areas north of the Amu Darya River, near the Afghanistan-USSR boundary.

The sections considered are ranging in age from the Lower (?) Cretaceous to the Middle-Upper Eocene. Precise age determinations are possible for the Cenomanian-Turonian interval (*Cuneolina* and *Dicyclina* bearing levels), and for the Maastrichtian, which yields Orbitoids. In the Paleogene interval isolated microfaunas allowed to recognize the Middle Paleocene, Lower and Middle-Upper Eocene on the base of planktonic Foraminifera.

According to the chronostratigraphic terminology used in the regions under examination from Central Asia, the Suzak, Alai and Turkestan stages have been recognized on the basis of Foraminifera, as well as of Mollusca and other megafossils (see Berizzi Quarto di Palo, p. 161).

Possibly some gaps exist in the whole region, but they cannot be demonstrated paleontologically since a number of levels, even if not barren, do not yield significant faunas.

Unfortunately, rich faunas are very rare and fossils are usually not well preserved. Therefore we are not in the best conditions to carry on detailed work. Each species is usually represented by only a few specimens.

A further difficulty is given by the local micropaleontological literature, which is scanty and sometimes unavailable.

The Foraminifera described come from the following localities and/or levels:

Farkhar section:

level 61 AE-87/12	*Cuneolina pavonia parva* Henson *Dicyclina schlumbergeri* Munier-Chalmas
level 61 AE-87/13	*Haplophragmoides* cf. *greigi* (Henson) *Cuneolina pavonia parva* Henson *Dicyclina schlumbergeri* Munier-Chalmas

Baba Darves section:

level 61 AD-30/10	*Cuneolina pavonia parva* Henson
level 61 AD-30	*Siderolites calcitrapoides* Lamarck *Orbitoides media* (d'Archiac)
level 61 AD-30/3	*Orbitocyclina minima* (Douvillé)
level 61 AD-30/5	*Orbitocyclina minima* (Douvillé)
sample 61 AD-35/1	*Orbitocyclina minima* (Douvillé)

Mohammad Aba outcrop:

sample 61 AD-34/1 — *Pseudotextulariella* sp.
Cuneolina pavonia parva Henson
Dicyclina schlumbergeri Munier-Chalmas

Ambar Koh section:

level 61 AE-89/2 — *Dentalina communis* (d'Orbigny)
Bulimina ovata d'Orbigny
Globorotalia ehrenbergi Bolli
Globigerina microsphaerica (Morozova)
Globigerina spiralis Bolli
Globigerina aff. *spiralis* Bolli
Globigerina triloculinoides Plummer

Barfaq section:

level 61 AE-100/3 — *Spiroplectammina monetalis* Bykova
Marginulina longiforma (Plummer)
Bulimina ovata d'Orbigny
Globorotalia quadratoseptata (Davidson & Morozova)
Globigerina mckannai White
Cibicides succedens Brotzen
Virgulina schreibersiana Cžjžek
Allomorphina conica Cushman & Todd
Gyroidina aff. *angustiumbilicata* Ten Dam
Gyroidinoides soldanii octocamerata (Cushman & Hanna)
Karreria fallax Rzehak

Ali Abad section:

level 61 AE-91/3 — *Vulvulina* sp.
Gaudryina sp.
Nodosaria bacillum Defrance
Nodosaria bacillum minor Hantken
Marginulina longiforma (Plummer)
Uvigerina elongata Cole

	Angulogerina wilcoxensis (Cushman & Ponton)
	Gyroidinoides scrobiculata (Cushman & Ponton) non Schwager
	Anomalina toddae Harris & Jobe

Tashkurgan section:

level 61 AD-59/12	*Siderolites calcitrapoides* Lamarck
level 61 AD-59/6	*Pararotalia heckeri* (Bykova)
	Chiloguembelina trinitatensis (Cushman & Renz)
	Pseudohastigerina wilcoxensis (Cushman & Ponton)
	Globorotalia traubi Gohrbandt
	Globigerina falsospiralis (Davidson & Morozova)
	Globigerina cf. *prolata* Bolli
	Globigerina pseudoeocaena pseudoeocaena Subbotina
level 61 AD-59/3	*Uvigerina spinicostata* Cushman & Jarvis
	Valvulineria iphigenia Samoilova
	Globorotalia aff. *opima nana* Bolli
	Globorotalia rotundimarginata (Subbotina)
	Globigerina officinalis Subbotina
	Globigerina tarchanensis Subbotina & Khutsieva
	Virgulina (?) *dibollensis* Cushman & Applin

Acknowledgments

The writer sincerely thanks V.A. Krasheninnikov, M. Ya. Serova and H.P. Luterbacher for sending rare important russian literature and is very indebted to prof. M.B. Cita for her assistence and valuable advice.

PALEONTOLOGICAL DESCRIPTIONS

The study has been carried out partly on thin sections, and partly on isolated specimens.

The classification proposed by Loeblich and Tappan (1964) in « Treatise on Invertebrate Paleontology » has been followed wherever possible in dealing with the systematic order.

Order Foraminifera

Suborder Textulariina

Superfamily Lituolacea

Family Lituolidae de Blainville, 1825

Subfamily Haplophragmoidinae Maync, 1952

Genus **Haplophragmoides** Cushman, 1910

Haplophragmoides cf. **greigi** (Henson, 1948)

Pl. 17, fig. 1-2

cf. 1948 *Cyclammina greigi* Henson. *Larger Imp. Foram,* p. 13, pl. 13, fig. 11, 15-17.
cf. 1965 *Haplophragmoides greigi* Hofker jr. *Foram. Apt. Alb. Spain,* p. 185, pl. 2, fig. 1-2.

Two specimens, sectioned near the axis, can be assigned to Henson's species. The lack of equatorial sections does not allow a sure identification. Wall agglutinated. Interior simple. For this reason, the specimens here considered are attributed to the genus *Haplophragmoides*, according to Hofker.

Sizes — Diameter mm 0.90
Thickness mm 0.43

Occurrence — The holotype comes from the Lower Cretaceous of Qatar. The species also occurs in Aptian-Albian sediments of Northern Spain.

Locality — Farkhar section. Level 61 AE-87/13.

Family Pavonitinidae Loeblich & Tappan, 1961

Subfamily Pfenderininae Smout & Sudgen, 1962

Genus **Pseudotextulariella** Barnard, 1953, emend. Charollais, Brönnimann & Zaninetti, 1966

Pseudotextulariella sp.

Pl. 17, fig. 3-6

Some specimens variously sectioned, contained in compact limestone.

Test similar to a broad cone, with straight sides, sometimes diverging in the final portion. Apex rounded, apertural face generally flat, gently concave, more depressed near the aperture in the final chambers. 6 pairs of chambers are visible, biserially arranged, semi-circular in shape in transversal section, rapidly increasing in the diameter. All the visible chambers are subdivided vertically by rare primary radial septa, alternatively more and less developed, extending from the periphery to half chamber: the center is not subdivided. No transversal septa are present. Proloculus and initial triserial whorl not visible. Aperture narrow, slit-like at the base of last chamber. Wall microgranular, smooth.

Sizes —	Diameter (end)	mm 0.40 to 0.47
	Diameter (middle)	mm 0.26 to 0.29
	Diameter (base)	mm 0.19 to 0.22
	Height of chambers	mm 0.05 to 0.06
	Apical angle 65°	

Remarks — According to Charollais, Brönnimann and Zaninetti (1966), the specimens here described are attributable to the genus ***Pseudotextulariella*** of primitive type since the biserial chambers are subdivided only with vertical partitions.

As far as we know, only one species without horizontal partitions has been described till now, *Pseudotextulariella salevensis* Charollais, Brönniman & Zaninetti, which differs from the Afghanistan specimens by having a smaller apical angle and a greater number and thinner vertical partitions.

Possibly it is a new species.

Locality — Mohammad Aba outcrop. Sample 61 AD-34/1.

Family TEXTULARIIDAE Ehrenberg, 1838

Subfamily SPIROPLECTAMMININAE Cushman, 1927

Genus **Spiroplectammina** Cushman, 1927

Spiroplectammina monetalis Bykova, 1953

Pl. 23, fig. 7 a-b

1953 *Spiroplectammina monetalis* Bykova. *Foram. Suzak Tajikistan*, p. 60, pl. 1, fig. 4.

Test biserial, wedge-shaped. The initial planispiral coil is very limited and not well visible. Eight pairs of chambers are present in the biserial part, separated by sutures slightly elevated, straight, tending to bend near the periphery, chiefly in the initial part of the test. In the middle part they are inflated. Periphery acute, not keeled. The last chamber is broken, but the aperture appears as a small slit at the base of the last chamber. Wall agglutinated, smooth, with abundant calcareous cement.

Sizes —	Length	mm 0.45
	Width	mm 0.35

Thickness	mm 0.23
Apical angle	60°

Occurrence — The holotype comes from the Tajikistan Depression, Suzak horizon (Lower Eocene).

Locality — Barfaq section. Level 61 AE-100/3.

Genus **Vulvulina** d'Orbigny, 1826

Vulvulina sp.

Pl. 21, fig. 1-2

Test wider than high, with keeled periphery, trapezoidal in shape, raised in the median part, consisting of 4 to 6 pairs of distinct chambers, curved and depressed. Sutures distinct and raised. Earliest chambers arranged planispirally and projecting downward below the remainder of the test. Aperture very narrow and elongate. Wall agglutinated, roughened especially along the sutures.

Sizes —	Length	mm 0.21
	Width	mm 0.29
	Thickness	mm 0.11
	Aperture	mm 0.05

Remarks — The specimens here described are very similar to *V. jarvisi* Cushman, lacking however, the last uniserial portion. It is possible that they belong to the microspheric generation: this assumption is supported by the presence of a well developed planispiral portion of the test.

Occurrence — *Vulvulina jarvisi* Cushman is common all over the world in Eocene sediments.

Locality — Ali Abad section. Level 61 AE-91/3.

Family Ataxophragmiidae Schwager, 1877

Subfamily Verneuilininae Cushman, 1911

Genus **Gaudryina** d'Orbigny, 1839

Gaudryina sp.

Pl. 21, fig. 5

Test triangular in shape, initially triserial, in the adult biserial. Transversal outline triangular with rounded margins, then ovoid. The ultimate and penultimate chambers increase very rapidly and are greatly inflated: they form more than half of the whole test. Sutures distinct only in the adult. Aperture slit-like at the base of last chamber. Wall agglutinated with abundant cement.

Sizes —	Length	mm 0.52
	Width	mm 0.30
	Thickness	mm 0.34

Specimens very rare.
Locality — Ali Abad section. Level 61 AE-91/3.

Subfamily Ataxophragminae Schwager, 1877

Genus **Cuneolina** d'Orbigny, 1839

Cuneolina pavonia d'Orbigny **parva** Henson, 1948

Pl. 17, fig. 8-9; Pl. 18, fig. 2

1948b *Cuneolina pavonia parva* Henson. *Trochamminidae*, p. 625, pl. 14, fig. 1-5; pl. 17, fig. 7-12; pl. 18, fig. 12-14.
1962 *Cuneolina pavonia parva* Sartoni and Crescenti. *Mesozoico App. Merid.*, p. 278, pl. 31, fig. 2; pl. 32; pl. 47, fig. 4-6.

Several specimens, variously sectioned, are assignable to the taxon described by Henson. They correspond rather well to the forms illustrated by Sartoni and Crescenti (1962) from the Southern Apennines.

The sections examined in the present work do not permit the separation of the two generations; the embryonal chamber of a megalospheric specimen is visible only in a single fragment.

In both the equatorial and axial section, the primary, secondary and radial septa are well-developed and clearly visible.

Sizes —	Length	about	mm 1.2
	Width (end)	about	mm 0.75
	Thickness	about	mm 0.35 to 0.40
	Height of chambers (end)		mm 0.12
	Proloculus		mm 0.12 x 0.17

Occurrence — Subspecies widespread in the Middle and Upper Cretaceous of the Near-East (Jordan, Palestine, Iraq, Iran) and in Egypt. Frequent in the *pavonia parva* zone of the Southern Apennines and in the Dinarids (Cenomanian).

Locality — Baba Darves section (level 61 AD-30/10). Farkhar section level 61 AE-87/12, 13). Mohammad Aba outcrop (sample 61 AD-34/1).

Family Dicyclinidae Loeblich & Tappan, 1964

Subfamily Dicyclininae Loeblich & Tappan, 1964

Genus **Dicyclina** Munier-Chalmas, 1887

Dicyclina schlumbergeri Munier-Chalmas, 1887

Pl. 18, fig. 1, 3-4

1887 *Dicyclina schlumbergeri* Munier-Chalmas. *Genres nouveaux*, p. XXXI.
1904 *Dicyclina schlumbergeri* Schlumberger and Choffat. *Spirocyclina*, p. 362, text-fig. 1-2.
1948b *Dicyclina schlumbergeri* Henson. *Trochamminidae*, p. 621, pl. 14, fig. 9.
1949 *Dicyclina schlumbergeri* Cuvillier and Szakall. *Foram. Aquitaine*, p. 29, pl. 11, fig. 6-7.
1960 *Dicyclina schlumbergeri* Radoičić. *Microfaciès Dinarides*, pl. 43, fig. 2.
1962 *Dicyclina schlumbergeri* Sartoni and Crescenti. *Mesozoico App. Merid.*, p. 279, pl. 47, fig. 8.

Axial and equatorial sections, although somewhat incomplete, are surely attributable to the form described by Munier-Chalmas. They are certainly very similar to those illustrated by Sartoni and Crescenti and by Radoičić, coming respectively from the Southern Apennines and from the Dinaric Alps.

The subdivisions and the radial and transversal secondary septa are clearly visible. No embryonic apparatus are visible.

Sizes —	Length	about	mm 1.75
	Width	about	mm 1.12
	Thickness		mm 0.40

Occurrence — Senonian of Martigues and of the Dinaric Alps. Cenomanian of the Ile Madame, Cenomanian-Senonian of Aquitania, *Cuneolina pavonia parva/Dicyclina schlumbergeri* zone of the Southern Apennines (Turonian-Senonian), Maastrichtian of the Qatar peninsula and of Iraq.

Locality — Farkhar section (level 61 AE-87/12, 13). Mohammad Aba outcrop (sample 61 AD-34/1).

Suborder Rotaliina

Superfamily Nodosariacea

Family Nodosariidae Ehrenberg, 1838

Subfamily Nodosariinae Ehrenberg, 1838

Genus **Nodosaria** Lamarck, 1812

Nodosaria bacillum Defrance, 1825

Pl. 22, fig. 4

1825 *Nodosaria bacillum* Defrance. *Dict. Sc. Natur.*, p. 127, pl. 13, fig. 4. (Fide Ellis & Messina).

1826 *Nodosaria bacillum* d'Orbigny. *Tabl. Méth. Ceph.*, p. 28, n. 34.
1953b *Nodosaria bacillum* Subbotina. *Lagenidae and Buliminidae*, p. 175, pl. 5, fig. 11 a-b (non 9, 10, 12).

Some fragments of this very elongate species consist of two or three subglobular chambers uniserially arranged and separated by narrowings which give to the form a nodular aspect. 11-12 well developed ribs are present along the whole test. Aperture not visible. Wall calcareous, smooth.

Sizes — Length mm 1.4
Width mm 0.5

Though fragmentary, the specimens correspond very well to the type.

Occurrence — Species common in the Tertiary sediments of the whole world.

Locality — Ali Abad section. Level 61 AE-91/3.

Nodosaria bacillum Defrance **minor** Hantken, 1875

Pl. 22, fig. 2-3

1875 *Nodosaria bacillum minor* Hantken. *Clavulina szaboi*, p. 26, pl. 11, fig. 7.
1953b *Nodosaria bacillum* Subbotina. *Lagenidae and Buliminidae*, p. 175, pl. 5, fig. 9, 10, 12 (non 11 a-b).

Some fragmentary specimens are attributable to this subspecies. They are generally cylindrical fragments of the initial part, consisting of 4 or 5 chambers with height minor than the diameter, covered by 11-12 longitudinal ribs, straight and well developed. The initial part can bear a spine, which, however, generally is not preserved. Aperture not visible. Wall calcareous, smooth.

Sizes — Length mm 1.00
Width mm 0.29

Remarks — Though fragmentary, our specimens are very characteristic. The subspecies differs from the typical form by not having narrowings corresponding with the sutures between the chambers and by not having globular chambers.

Occurrence — It is known from the Eocene-Oligocene of Southern USSR, Hungary, Italy.

Locality — Ali Abad section. Level 61 AE-91/3.

Genus **Dentalina** Risso, 1826

Dentalina communis (d'Orbigny, 1826)

Pl. 22, fig. 1

1826 *Nodosaria communis* d'Orbigny. *Tabl. Méth. Ceph.*, pl. 105, fig. 0.
1840 *Nodosaria communis* d'Orbigny. *Foram. Craie blanche*, p. 13.

Test very elongate, slender, curved, gently tapering, rounded in transversal outline. Initial end rounded. 8 chambers, gradually increasing, wider than high, separated by oblique sutures. The last three chambers are equidimensional. Final chamber inflated, separated from the preceeding one by means of a slightly depressed suture, elongate towards the radiate aperture.

Sizes —	Length	mm 0.85
	Width (end)	mm 0.20
	Width (base)	mm 0.125

Occurrence — Very common in the Tertiary of the whole world.
Locality — Ambar Koh section. Level 61 AE-89/2.

Genus **Marginulina** d'Orbigny, 1826

Marginulina longiforma (Plummer, 1926)

Pl. 22, fig. 5-7

1926 *Cristellaria longiforma* Plummer. *Midway*, p. 102, pl. 13, fig. 4 a-b.

Shell elongate, broad, convex in the median part, with acute periphery. Initially planispiral, then consisting of uniserially arranged oblique chambers. Breadth of the chambers of the uniserial part about 5-6 times the height. Sutures of the uniserial portion strongly limbate in the central part of the shell, tending to attenuate in the vicinity of the periphery. They are generally straight, slightly curving downward in proximity to the lateral margins. Aperture eccentric, terminal, radiate.

Sizes —	Length	mm 0.90;	1.2
	Width	mm 0.78;	0.5
	Thickness	mm 0.37;	0.31

Remarks — Two generations are present. The microspheric forms are more squat and with a more developed spiral portion. To generation A are attributed the more elongate forms, which also show a more developed uniserial portion.

The imperfect preservation does not permit the observation and measurement of the embryonal chamber.

Occurrence — The holotype comes from the Eocene of Texas.

Locality — Barfaq section (level 61 AE-100/3); Ali Abad section (level 61 AE-91/3).

Superfamily Buliminacea

Family Buliminidae Jones, 1875

Subfamily Bulimininae Jones, 1875

Genus **Bulimina** d'Orbigny, 1826

Bulimina ovata d'Orbigny, 1846

1846 *Bulimina ovata* d'Orbigny. *Bassin de Vienne*, p. 185, pl. 11, fig. 13-14.
1953 *Bulimina ovata* Bykova. *Foram. Susak Tajikistan*, p. 68, pl. 2, fig. 4-6.
1953b *Bulimina ovata* Subbotina. *Lagenidae and Buliminidae*, p. 210, pl. 9, fig. 15-16.
1953 *Bulimina ovata* Beckmann. *Foram. Barbados*, p. 366, pl. 21, fig. 13.

Numerous specimens are attributable to this well-known species.

Occurrence — Recorded from the Tertiary of the whole world.

Locality — Barfaq section (level 61 AE-100/3); Ambar Koh section (level 61 AE-89/2).

Family Uvigerinidae Haechel, 1894

Genus **Uvigerina** d'Orbigny, 1826

Uvigerina elongata Cole, 1927

Pl. 21, fig. 6-7

1927 *Uvigerina elongata* Cole. *Foram. Guayabal*, p. 26, pl. 4, fig. 2-3.
1937 *Uvigerina elongata* Cushman and Edwards. *Amer. Eocene Uvigerina*, p. 78, pl. 11, fig. 15-16.
1953 *Uvigerina elongata* Bykova. *Foram. Suzak Tajikistan*, p. 74, pl. 2, fig. 9.

Test elongate subfusiform, slender, initial part triserial, tending to become uniserial. Few chambers subglobular separated by depressed sutures. Periphery lobate. Aperture rounded, terminal with a small neck. Wall calcareous, smooth.

Sizes — Length mm 0.26
Width mm 0.12

Occurrence — The present species is known from the Middle Eocene and the lower part of Upper Eocene of Mexico and Luisiana, from the Lower Eocene of the Tajik Depression.

Locality — Ali Abad section. Level 61 AE-91/3.

Uvigerina spinicostata Cushman & Jarvis, 1929

Pl. 23, fig. 2

1929 *Uvigerina spinicostata* Cushman and Jarvis. *N. Foram. Trinidad*, p. 12, pl. 3, fig. 9-10.
1937 *Uvigerina spinicostata* Cushman and Edwards. *Amer. Eocene Uvigerina*, p. 83, pl. 12, fig. 11-12.
1953 *Uvigerina spinicostata* Beckmann. *Foram. Barbados*, p. 368, pl. 21, fig. 19.

Shell elongate, from fusiform to subconical. Transverse section subrounded. Apex pointed. Triserial coiling, tending to become uniserial. Chambers globose, separated by clearly visible depressed sutures. Perforate calcareous wall, covered by projecting longitudinal sharp-edged costae. They are interrupted in correspondence with the sutures; the surface of the shell is spinose in the lower part of the chambers, particularly in the initial spiral. The maximum inflation is reached in the median part of the shell (in forms tending to become uniserial), or in the topmost part. The ornamentation of the final chamber is less accentuated, especially in correspondence with the apertural face. Terminal aperture rounded, with a reduced neck.

Sizes — Length mm 0.40
Width mm 0.18

Remarks — The various types described above probably belong to different generations. However, the specimens available are too scanty to allow any sure statement.

The specimens considered here are close to the type and to the forms illustrated by Beckmann, but have notably smaller dimensions (about 1/2). Also, the ornamentation of the final chamber is less accentuated in our specimens than in the type.

Occurrence — Found in the Middle Eocene and Lower Oligocene of Barbados, the Eocene-Oligocene of Cuba, the basal Oligocene of Trinidad.

Locality — Tashkurgan section. Level 61 AD-59/3.

Genus **Angulogerina** Cushman, 1927

Angulogerina wilcoxensis (Cushman & Ponton, 1932)

Pl. 21, fig. 4, 8

1932 *Pseudouvigerina wilcoxensis* Cushman and Ponton. *Foram. Wilcox Alabama*, p. 66, pl. 8, fig. 18.
1937 *Pseudouvigerina wilcoxensis* Glaessner. *Problems Paleont.*, p. 374, pl. 2, fig. 21 a-b.
1948 *Angulogerina wilcoxensis* Brotzen. *Swedish Paleocene*, p. 63, pl. 6, fig. 7.
1953 *Angulogerina wilcoxensis* Bykova. *Foram. Suzak Tajikistan*, p. 75, pl. 2, fig. 10-11.

Test elongate, slender, triangular in transverse section. Peripheral margins truncate with double keels very close to one another, not well developed in the last chambers, straight and non interrupted along the whole test. Lateral faces flat or slightly concave. Sutures curved, sometimes slightly depressed. The last chambers are more inflated, separated by distinct sutures. Aperture rounded, terminal with a very small neck. Wall calcareous smooth.

Sizes — Length mm 0.27
Width mm 0.14

Some specimens, though not well preserved, may be referred to the species of Cushman and Ponton.

Occurrence — The species is known from the Upper Paleocene-Lower Eocene of Alabama, Paleocene of Northern Europe and Southern USSR, and in the Suzak horizon of the Tajik Depression.

Locality — Ali Abad section. Level 61 AE-91/3.

Superfamily Discorbacea

Family Discorbidae Ehrenberg, 1838

Subfamily Bagginidae Cushman, 1927

Genus **Valvulineria** Cushman, 1926

Valvulineria iphigenia Samoilova, 1947

Pl. 23, fig. 3 a-c, 5 a-c

1947 *Valvulineria iphigenia* Samoilova. *Foram. Paleogene Crimea*, p. 92, pl. 2, fig. 24-26.
1955 *Valvulineria iphigenia* Maslakova. *Biostrat. Ukraina*, p. 66, pl. 9, fig. 10-12.

Shell ovoid; a low spiral with rounded periphery and only slightly lobate shape. On the dorsal side two whorls of chambers are visible, with five chambers in the final whorl. The initial chambers are hardly discernible, but those of the final whorl are of subtriangular shape and grow regularly; the last is appreciably larger, swollen and claw-shaped, and can make up about 1/3 of the whole shell. Sutures radial to retroflex, slightly depressed. On the umbilical, involute side are four chambers of subtriangular shape and rounded, and a fifth chamber, the last, which is somewhat swollen and extends into the umbilical region. Sutures radial and depressed. Umbilicus open, narrow, rather deep, partially covered by the extension of the last chamber. Aperture slit-like, interiomarginal, umbilical-extraumbilical. Wall calcareous, finely perforate.

Sizes —

		I	II
Maximum diameter	mm	0.30;	0.35
Minimum diameter	mm	0.23;	0.32
Thickness	mm	0.13;	0.20

Remarks — This species is rather frequent and exhibits a certain amount of variability which is clearly evident in the population of this sample.

In addition to the typical forms were discovered:

— Very elongate specimens in which the breadth of the shell is equal to about 1/2 of the length, and having more depressed and slightly retroflexed sutures, particularly those separating the final chambers, and an initial spiral which is more elevated and rising with respect to the plane of the chambers of the final whorl.

— Specimens in which breadth and length are approximately the same; almost plano-convex, with convexity on the ventral side mostly due to the more swollen final chamber of which the inflation is slightly turned towards the umbilicus. Periphery rounded and shape only slightly lobate. The umbilicus is sometimes slightly broader than in the typical form.

Transitional forms between the three types described are present. This led to the conclusion that these specimens belong to a single species. Further studies could, however, indicate the presence of megaspheric and microspheric generations.

Occurrence — The type comes from the Upper Eocene of the Crimea (*Almaena taurica* zone); it is also encountered in the whole of the Upper Eocene and in the Lower/Middle Oligocene of the same area and in the Carpathians always in the Upper Eocene. Kurgalimova (1967) recorded *Valvulineria iphigenia* in the Upper Eocene of the Pre-Aral.

Locality — Tashkurgan section. Level 61 AD-59/3.

Superfamily Rotaliacea

Family Rotaliidae Ehrenberg, 1839

Subfamily Rotaliinae Ehrenberg, 1839

Genus **Pararotalia** Le Calvez, 1949

Pararotalia heckeri (Bykova, 1959)

Pl. 23, fig. 6 a-c

1959 *Rotalia heckeri* Bykova. *Foram. Central Asia*, p. 585, pl. 1, fig. 10-12.

Shell biconvex with spiral side more elevated than the umbilical side. Periphery acute and strongly lobate. A peripheral spine is present on each chamber of the last whorl; the peripheral spines are more developed in the first part of the last whorl. On the dorsal side 2-2½ whorls are visible, with seven chambers gently inflated in the last one. Sutures depressed, straight or gently curved. Spiral suture depressed. The initial part of the test is convex and elevated on the last whorl; the chambers are not distinguishable.

The ventral side is involute; seven chambers are visible, inflated, triangular in shape, separated by deeply depressed radial sutures. The umbilicus is filled by a pillar, more elevated than the chambers, surrounded by an annular depression. The last chamber is particularly inflated. Aperture at the base of the last chamber, not well visible. Wall calcareous finely perforate.

Sizes —	Maximum diameter	mm 0.44
	Minimum diameter (with spines)	mm 0.44
	Thickness	mm 0.15

Very similar to the holotype.

Occurrence — Recorded in the Ferghana Valley, in clayey-marly deposits of Early to Middle Eocene age.

Locality — Tashkurgan section. Level 61 AD-59/6.

Family Calcarinidae Schwager, 1876

Genus **Siderolites** Lamarck, 1801

Siderolites calcitrapoides Lamarck, 1801

Pl. 20, fig. 1-6

1801 *Siderolites calcitrapoides* Lamarck. *Animaux sans vertèbres*, p. 377 (Fide Ellis & Messina).

1907 *Siderolites calcitrapoides* Osimo. *Genere Siderolites*, p. 281, pl. 1, fig. 5, 18.

Numerous specimens in variously oriented sections are attributable with certainty to the species of Lamarck. They are generally quadrispinate with well developed spines. The wall consists of two distinct layers: a somewhat thick calcareous external one, coarsely perforated and crossed by numerous pillars, themselves of noteworthy dimensions; an internal one which flexes periodically to form the chambers, thin (about 1/10 of the external one) and finely perforated.

Embryonal chamber spherical, not always visible: it is possible to measure it in several incomplete sections.

Very distinct canal system with the abundant ramifications localised particularly in the peripheral and in the spine zones.

Sizes —	Diameter (with spines)	mm 2.2 to 3.4 x 2.0 to 2.3
	Thickness	mm 0.75 to 0.90
	Spines length about	mm 1
	width	mm 0.35 to 0.80
	Proloculus	mm 0.09

Occurrence — Species very important, of distribution limited to the Maastrichtian. It has been encountered in Europe and Asia in beds of this age.

Locality — Tashkurgan section (level 61 AD-59/12). Baba Darves section (level 61 AD-30).

Superfamily Globigerinacea

Family Heterohelicidae Cushman, 1927

Subfamily Heterohelicinae Cushman, 1927

Genus **Chiloguembelina** Loeblich & Tappan, 1956

Chiloguembelina trinitatensis (Cushman & Renz, 1942)

Pl. 24, fig. 1 a-b

1942 *Gümbelina trinitatensis* Cushman and Renz. *Paleocene Soldado Rock*, p. 8, pl. 2, fig. 8.

1957 *Chiloguembelina trinitatensis* Beckmann. *Chiloguembelina Trinidad*, p. 91, pl. 21, fig. 7; text-fig. 15.

Test elongate, tapering towards the base, slightly compressed laterally, consisting of 6 pairs of globular chambers, separated by straight depressed sutures, rapidly increasing in size. Periphery gently lobate. Aperture not visible. Wall calcareous, finely perforate, smooth.

Sizes —	Length	mm 0.26
	Width	mm 0.17
	Thickness	mm 0.11

Our specimens are not well preserved.
Occurrence — Upper Paleocene of Central America.
Locality — Tashkurgan section. Level 61 AD-59/6.

Family HANTKENINIDAE Cushman, 1927
Subfamily HASTIGERININAE Bolli, Loeblich & Tappan, 1957
Genus **Pseudohastigerina** Banner & Blow, 1959

Pseudohastigerina wilcoxensis (Cushman & Ponton, 1932)

Pl. 24, fig. 2 a-c

1932 *Nonion wilcoxensis* Cushman and Ponton. *Foram. Wilcox Alabama*, p. 64, pl. 8, fig. 11 a-b.
1953a *Globigerinella voluta* Subbotina. *Globigerinidae*, p. 87, pl. 13, fig. 13-15.

Test small, bilaterally symmetrical, involute, deeply umbilicate on both sides. 5 inflated chambers are visible, the last and penultimate irregularly shaped. Sutures on both sides straight and depressed. Aperture slit-like, at the base of the last chamber. Periphery rounded. Wall calcareous finely perforate.

Sizes —	Maximum diameter	mm 0.23
	Minimum diameter	mm 0.18
	Thickness	mm 0.11

Remarks — Subbotina (1953) illustrates as *Globigerinella voluta* (White) a form identical to Cushman and Ponton's *N. wilcoxensis*. This attribution is considered incorrect, since White's species is twice as large and is incompletely involute.
Occurrence — Lower Eocene and lower Middle Eocene of the Tethys.
Locality — Tashkurgan section. Level 61 AD-59/6.

Family GLOBOROTALIIDAE Cushman, 1927
Subfamily GLOBOROTALIINAE Cushman, 1927
Genus **Globorotalia** Cushman, 1927

Globorotalia ehrenbergi Bolli, 1957

Pl. 24, fig. 7 a-c, 8 a-c

1957 *Globorotalia ehrenbergi* Bolli. *Lizard Springs*, p. 77, pl. 20, fig. 18-20.
1960 *Globorotalia ehrenbergi* Bolli and Cita. *Paleocene Paderno d'Adda*, p. 382, pl. 35, fig. 4 a-c.

1965 *Globorotalia ehrenbergi* Shutzkaja. *G. compressa group*, p. 181, pl. 1, fig. 4.
1967 *Planorotalia pseudomenardii membraniformis* Morozova. *Danian-Paleocene Kopet-Dag*, p. 194, pl. 6, fig. 1-2.

Shell trochospiral, with spiral side slightly elevated and weakly biconvex profile. Shell comprising 2-2½ whorls. Five chambers were counted in the last whorl, regularly increasing in size, of petaloid shape, separated by arcuate depressed and retroflexed sutures on the dorsal side. The sutures are depressed and radial on the ventral side which shows a narrow deep umbilicus. The final chamber may be equal in size to the penultimate one, or even slightly smaller. Periphery acute and, in the final chamber, sometimes bearing a fine keel. Aperture interiomarginal, umbilical to extraumbilical with a rather low arch. Wall calcareous, finely perforate.

Sizes —	Maximum diameter	mm 0.29;	0.31
	Minimum diameter	mm 0.22;	0.26
	Thickness	mm 0.14;	0.15

Remarks — The species is rather abundant and is highly variable; individuals are found exhibiting a clearly biconvex shape, with a subrounded periphery, and practically devoid of a keel. The number of chambers in the final whorl can vary from 4 to 6 and equidimensional forms are present together with more elongate forms.

The new form described and illustrated by Morozova (1967) as *Planorotalia pseudomenardii membraniformis*, is considered by the present author to be within the species here described. In the present fauna specimens are found which are identical to those illustrated by Morozova and which cannot be distinguished from *G. ehrenbergi*. Consequently *P. pseudomenardii membraniformis* is here considered to be a younger synonym of Bolli's *G. ehrenbergi*.

The stratigraphical position of the two species confirms the proposed synonymy; both of them are considered to be directly ancestral to *G. pseudomenardii*, and are present in the Middle Paleocene.

Occurrence — The holotype of this species comes from the Middle Paleocene of Trinidad; it has been found in beds of the same age in Cuba, Spain, Austria, Italy (Southern Alps and Central Apennines), Crimea, the Caucasus, and Kopet-Dag.

Locality — Ambar Koh section. Level 61 AE-89/2.

Globorotalia aff. **opima nana** Bolli, 1957

Pl. 24, fig. 5 a-c

Test trochospiral, equally biconvex, subquadrate in shape, with compact equatorial periphery and rounded, but slightly compressed, axial periphery. 3

whorls are visible with four chambers, of almost the same size, in the last whorl. Sutures curved and slightly depressed on the spiral side. On the umbilical side, chambers subquadrate separated by radial, slightly depressed sutures, crossing at about 90°. Umbilicus deep, but very small. Aperture slit-like with a narrow rim, along the base of the last chamber. Wall calcareous, strongly rugose.

Sizes —	Maximum diameter	mm 0.26
	Minimum diameter	mm 0.23
	Thickness	mm 0.16

Remarks — The species here described is closely related with *G. opima nana* Bolli (1957, p. 118, pl. 28, fig. 3 a-c), but it has a greater number of chambers arranged in about 3 whorls, while Bolli's species has just 2 whorls. *G. opima nana* besides has a more lobate periphery and all the sutures more depressed.

Locality — Tashkurgan section. Level 61 AD-59/3.

Globorotalia quadratoseptata (Davidson & Morozova, 1964)

Pl. 24, fig. 10 a-c

1964 *Acarinina quadratoseptata* Davidson and Morozova. *Foram. Bukhara*, p. 28, pl. 2, fig. 1-3; text-fig. 1.

Test trochospiral, ovoidal, plano-convex, with spiral side almost flat, umbilical side somewhat convex. Equatorial peripery gently lobate, axial periphery rounded but subangular. 2½ whorls visible; 5 subglobular chambers in the last whorl, gradually increasing in size, separated by straight little depressed sutures. On the umbilical side the chambers are subtriangular in shape, inflated near the umbilicus, which is narrow and deep. Sutures straight and depressed. Aperture a small slit, umbilical-extraumbilical, at the base of the last chamber. Wall calcareous perforate, with fine spines.

Sizes —	Maximum diameter	mm 0.29
	Minimum diameter	mm 0.23
	Thickness	mm 0.16

Remarks - The Authors originally figured 4 specimens very different from one another. Our form corresponds very well to the holotype, but differs from the paratypes. The considered species is very rare in our material, therefore it cannot confirm its high degree of variability.

Occurrence — Upper Paleocene (Thanetian) of the Tajik Depression and Kopet-Dag.

Locality — Barfaq section. Level 61 AE-100/3.

Globorotalia rotundimarginata (Subbotina, 1953)

Pl. 24, fig. 9 a-c

1953a *Acarinina rotundimarginata* Subbotina. *Globigerinidae*, p. 234, pl. 25, fig. 1-2.

Test trochospiral, slightly elongate, inequally biconvex, with the umbilical side more convex. Equatorial periphery slightly lobate, axial periphery rounded. About 15 chambers arranged in 2½ to 3 whorls, with 5 subglobular chambers in the last one, gradually increasing, separated by slightly curved, depressed sutures. On the umbilical side, chambers, subtriangular in shape, slightly inflated near the umbilicus, which is small and deep. The last chamber is more inflated than the others. Sutures radial and deep. Aperture slit-like, at the base of the last chamber, in extraumbilical position. Wall calcareous with abundant but small spines.

Sizes —	Maximum diameter	mm 0.34
	Minimum diameter	mm 0.29
	Thickness	mm 0.19
	Thickness of last chamber	mm 0.16

Occurrence — Frequent in the Middle-Upper Eocene of Southern USSR and Mediterranean Basin (personal observation).

Locality — Tashkurgan section. Level 61 AD-59/3.

Globorotalia traubi Gohrbandt, 1963

Pl. 24, fig. 4 a-c

1963 *Globorotalia* (?) *traubi* Gohrbandt. *Paläogen Helvetikum*, p. 56, pl. 3, fig. 16-18.

Test trochospiral, subcircular in outline, inequally biconvex, with the umbilical side more convex than the spiral side. Equatorial periphery gently lobate, axial periphery rounded. On the spiral side 2½ whorls are visible: 6 chambers of about the same size constitute the final whorl. They are separated by curved, depressed sutures. On the umbilical side, the chambers are separated by radial, depressed sutures. Umbilicus small and deep. Aperture slit-like, at the base of the last chamber, umbilical-extraumbilical. Wall calcareous, perforate, rugose.

Sizes —	Maximum diameter	mm 0.25
	Minimum diameter	mm 0.21
	Thickness	mm 0.16

Species not frequent in our samples.

Occurrence — The holotype comes from Lower Eocene sediments of Austria.

Locality — Tashkurgan section. Level 61 AD-59/6.

Family Globigerinidae Carpenter, Parker & Jones, 1862

Subfamily Globigerininae Carpenter, Parker & Jones, 1862

Genus **Globigerina** d'Orbigny, 1826

Globigerina falsospiralis (Davidson & Morozova, 1964)

Pl. 25, fig. 7 a-c, 8 a-c

1957 *Globigerina spiralis* Loeblich and Tappan. *Gulf Atlantic Coastal Plains*, p. 182, pl. 47, fig. 3; pl. 51, fig. 7.

1964 *Acarinina falsospiralis* Davidson and Morozova. *Foram. Bukhara*, p. 26, pl. 1, fig. 5.

Shell trochospiral to streptospiral, with 15-18 globular chambers disposed in 3½ whorls, very rapidly increasing in height, separated by deep sutures slightly curved in the early stage of development, straight in the last whorls. The last chamber has a peculiar form and generally is displaced towards the umbilicus. On the umbilical side, 5 chambers and a narrow umbilicus may be observed. Equatorial periphery lobate. Aperture a low small arch, umbilical, at the base of the last chamber. Wall calcareous perforate with fine pores and spines.

Sizes —	Maximum diameter	mm 0.30;	0.25
	Minimum diameter	mm 0.25;	0.20
	Thickness	mm 0.19;	0.27

Occurrence — Upper Paleocene of the Tajik Depression and of the Gulf and Atlantic Coastal Plains.

Locality — Tashkurgan section. Level 61 AD-59/6.

Globigerina mckannai White, 1928

Pl. 25, fig. 3 a-c

1928 *Globigerina mckannai* White. *Foram. Tampico Area*, p. 194, pl. 27, fig. 16 a-c.

1957 *Globorotalia mckannai* Bolli. *Lizard Springs*, p. 79, pl. 19, fig. 16-18.

1960 *Globorotalia mckannai* Bolli and Cita. *Paleocene Paderno d'Adda*, p. 383, pl. 33, fig. 6 a-c.

Test trochospiral, spiral side nearly flat to slightly convex, umbilical side strongly convex. Equatorial periphery practically circular, not lobate, axial periphey rounded. 2½ whorls are visible with 5 subglobular chambers in the last whorl, gradually increasing, separated by gently curved, sligthly depressed sutures. On the umbilical side the chambers, triangular in shape, are separated by straight depressed sutures. Umbilicus deep and narrow. Aperture a low irregular arch at the base of the last chamber, umbilical to extraumbilical. Wall calcareous perforate with fine spines.

Sizes —	Maximum diameter	mm 0.23
	Minimum diameter	mm 0.21
	Thickness	mm 0.16

Notwithstanding the imperfect preservation, our specimens are very similar to the typus.

Occurrence — Common in the Upper Paleocene of the Tethys.

Locality — Barfaq section. Level 61 AE-100/3.

Globigerina microsphaerica (Morozova, 1967)

Pl. 25, fig. 5 a-c

1967 *Acarinina microsphaerica* Morozova. *Kopet-Dag*, p. 195, pl. 6, fig. 3-4.

Test trochospiral with a well developed spiral consisting of about 17 globular chambers, arranged in 3½ whorls, gradually increasing in height. Equatorial periphery lobate. In the last whorl there are 4 chambers, the last of which is compressed. Sutures almost straight, very depressed on both sides. Umbilical area flattened. Aperture slit-like, large and elongated at the base of the last chamber. Wall calcareous perforate, with fine spines.

Sizes —	Maximum diameter	mm 0.30
	Minimum diameter	mm 0.25
	Thickness	mm 0.20

Remarks — Even if the aperture is very elongated and extends beyond the umbilical area, the taxon under examination is considered as belonging to the genus *Globigerina*. It differs from *G. turgida* Finlay by having a higher spiral, a greater number of chambers and a narrower umbilicus.

Occurrence — Frequent in the Middle-Upper Paleocene of Southern USSR.

Locality — Ambar Koh section. Level 61 AE-89/2.

Globigerina officinalis Subbotina, 1953

Pl. 25, fig. 1 a-c, 6 a-c

1953a *Globigerina officinalis* Subbotina. *Globigerinidae*, p. 78, pl. 11, fig. 1-2, 6-7.
1962 *Globigerina officinalis* Blow and Banner. *Mid-Tertiary*, p. 88, pl. 9, fig. A-C; text-fig. 16.

Test trochospiral, subquadrate in shape, consisting of about three whorls of subglobular inflated chambers arranged four in a whorl. Equatorial periphery gently lobate, axial periphery rounded. Chambers of the last whorl are more inflated on the umbilical side than on the spiral side, generally very slowly increasing. Sutures slightly curved to nearly radial on the spiral side, subradial on the umbilical one, depressed on both sides. Umbilicus almost closed. Aperture, at the base of the last chamber, a low small arch with a narrow rim. Wall calcareous finely perforate, hispid.

Sizes —	Maximum diameter	mm 0.19 ;	0.27
	Minimum diameter	mm 0.155;	0.23
	Thickness	mm 0.12 ;	0.19

Remarks — In the material under examination some specimens exist, larger in size and less lobate in shape than the ones here described, with a small aperture without rim: they too are attributed to Subbotina's species, since there are transitional forms (see fig. 6 a-c).

Occurrence — Frequent in the Tethys area in sediments of Upper Eocene-Oligocene age.

Locality — Tashkurgan section. Level 61 AD-59/3.

Globigerina cf. **prolata** Bolli, 1957

Pl. 24, fig. 3 a-c

cf. 1957 *Globigerina prolata* Bolli. *Lizard Springs*, p. 72, pl. 15, fig. 24-26.

Test elongate, low trochospiral, biconvex. Equatorial periphery gently lobate, axial periphery rounded. 2 whorls are visible: the initial part is confused, 5 subglobular chambers gradually increasing are visible in the last whorl, separated by slightly oblique and depressed sutures on the spiral side. On the umbilical side the chambers are separated by very depressed and straight sutures. Umbilicus deep fairly large. Aperture a low arch with a fine lip, extraumbilical, at the base of the last chamber. Wall calcareous perforate, rugose or with spines.

Sizes —	Maximum diameter	mm 0.23
	Minimum diameter	mm 0.19
	Thickness	mm 0.14

Remarks — Even if morphologically they are very similar, the specimens here considered, from the Lower Eocene of NE Afghanistan, cannot be identified with *G. prolata* Bolli, because of the apertural character: in fact the aperture is umbilical to extraumbilical, very low and elongated in Bolli's species, while it appears as a small rimmed arch, extraumbilical in position, in our specimen.

Occurrence — *Globigerina prolata* Bolli comes from the Lower Eocene of Trinidad.

Locality — Tashkurgan section. Level 61 AD-59/6.

Globigerina pseudoeocaena pseudoeocaena Subbotina, 1953 (1)

Pl. 24, fig. 6 a-c

1953a *Globigerina pseudoeocaena pseudoeocaena* Subbotina. *Globigerinidae,* p. 67, pl. 4, fig. 9; pl. 5, fig. 1-2.

Test trochospiral, triangular in shape, consisting of 2 whorls with 4 globular chambers in the last one, rapidly increasing. The last chamber occupies about half of the last whorl. Equatorial periphery strongly lobate, axial periphery rounded.

In both dorsal and umbilical sides the sutures are straight, strongly depressed. On the ventral side four chambers are visible; umbilicus deep, of medium size. Aperture at the base of last chamber, slit-like, with a thin rim. Wall calcareous perforate and cancellated.

Sizes —	Maximum diameter	mm 0.29
	Minimum diameter	mm 0.25
	Thickness	mm 0.17

Remarks — This species is very similar to *G. yeguaensis* Weinzierl & Applin, but differs by having 4 chambers in the last whorl less rapidly increasing, less deep sutures and consequently less lobate periphery, a larger umbilicus, a lip not well developed. It differs from *G. triangularis* White by having four chambers in the last whorl instead of three, more lobate periphery, sutures more deeply depressed and a well developed umbilicus.

(1) Recently, Hagn and Lindenberg (1969) consider this taxon as junior synonym of *Globigerina eocaena* Gümbel.

Occurrence — Widely represented in the Lower and Middle Eocene of Southern USSR, Caucasus, Crimea, etc.

Locality — Tashkurgan section. Level 61 AD-59/6.

Globigerina spiralis Bolli, 1957

Pl. 25, fig. 10 b

1957 *Globigerina spiralis* Bolli. *Lizard Springs,* p. 70, pl. 16, fig. 16-18.
1960 *Globigerina spiralis* Bolli and Cita. *Paleocene Paderno d'Adda,* p. 372, pl. 34, fig. 2 a-c.

Rare specimens, well comparable to the holotype as well as to subsequent representations, are present in the material investigated.

Occurrence — Early-Middle Paleocene of the Tethys.

Locality — Ambar Koh section. Level 61 AE-89/2.

Globigerina aff. **spiralis** Bolli, 1957

Pl. 25, fig. 9 a-c

Test globular, medium to high trochospiral, with spiral side distinctly convex. Equatorial periphery almost not lobate, axial periphery rounded. Three whorls are visible on the dorsal side with 5 globular chambers in the last whorl; sizes of the chambers rapidly increase in both first and second whorl, in the last one more gradually. The last chamber is smaller than the penultimate and is displaced towards the ventral side. Sutures straight or gently curved, depressed.

Five chambers are visible on the ventral side, triangular in shape, separated by sutures straight but strongly depressed. Umbilicus practically absent. Aperture at the base of the last chamber, a low arch with a very thin lip. Wall calcareous rugose to spinose, smooth in the last chamber.

Sizes —	Maximum diameter	mm 0.35
	Minimum diameter	mm 0.34
	Thickness	mm 0.25

Remarks — The taxon under examination, which is represented by very rare specimens, differs from *G. spiralis* Bolli by having a higher spiral, not well developed umbilicus and less lobate equatorial periphery. It may be separated from *Acarinina subsphaerica* (Subbotina) by having less chambers in the last whorl and the aperture umbilical instead of umbilical-extraumbilical.

Locality — Ambar Koh section. Level 61 AE-89/2.

Globigerina tarchanensis Subbotina & Khutsieva, 1950

Pl. 25, fig. 2 a-c

1950 *Globigerina tarchanensis* Subbotina and Khutsieva. In: Bogdanovich, *Foram. Ciscaucasia*, p. 173, pl. 10, fig. 5 a-c.
1953a *Globigerina tarchanensis* Subbotina. *Globigerinidae*, p. 61, pl. 3, fig. 13.

Shell low trochospiral, equally biconvex. Equatorial periphery lobate, axial periphery rounded. On the spiral side, 13 globular chambers arranged in about 2-2½ whorls are visible, with 5 chambers in the last whorl. The chambers are rapidly increasing in size in the initial whorls, while those of the last whorl are almost constant in size. The last chamber is displaced towards the umbilicus. Sutures depressed, straight or gently curved. On the umbilical side, the chambers, globular, are separated by deep straight sutures. Umbilicus deep and narrow. Aperture a slit at the base of the last chamber, not well visible. Wall calcareous, finely pitted.

Sizes — Diameter mm 0.17
Thickness mm 0.11

Remarks — The species here considered is very close to *G. spiralis* Bolli but it is distinguished by having a less convex spiral side, fewer chambers and a lower aperture.

Occurrence — *Globigerina tarchanensis* Subbotina & Khutsieva is recorded in Miocene deposits from Crimea and Caucasus. Forms very similar to the one here described, are present in some levels, Eocene in age, from the Mediterranean Basin (personal observation).

Locality — Tashkurgan section. Level 61 AD-59/3.

Globigerina triloculinoides Plummer, 1926

Pl. 25, fig. 4 a-b

1926 *Globigerina triloculinoides* Plummer. *Midway*, p. 134, pl. 8, fig. 10.
1960 *Globigerina triloculinoides* Bolli and Cita. *Paleocene Paderno d'Adda*, p. 373, pl. 33, fig. 1 a-c.

Rare specimens may be referred to this well known species.

Occurrence — Early-Middle Paleocene of the Tethys.

Locality — Ambar Koh section. Level 61 AE-89/2.

Superfamily Orbitoidacea

Family Cibicididae Cushman, 1927

Subfamily Cibicidinae Cushman, 1927

Genus **Cibicides** de Montfort, 1808

Cibicides succedens Brotzen, 1948

Pl. 21, fig. 11 a-b

1944 *Cibicides cryptomphalus hercegovinensis* Ten Dam. *Pal. Eoc. Foram.*, p. 132, pl. 5, fig. 9. (Fide Brotzen, 1948).
1948 *Cibicides succedens* Brotzen. *Swedish Paleocene*, p. 80, pl. 12, fig. 1-2; text-fig. 21.
1953 *Cibicides succedens* Bykova. *Foram. Suzak Tajikistan*, p. 94, pl. 5, fig. 2 a-c.

Test trochospiral, plano-convex to biconvex, with the greater convexity on the ventral side. Spiral side almost involute; eleven chambers subtriangular in shape in the last whorl, practically flat, separated by gently curved and slightly depressed sutures. On the umbilical side, the chambers are triangular in shape, separated by curved slightly depressed sutures. A distinct central plug fills the umbilicus. Axial periphery acute. Aperture slit-like at the base of the last chamber, extending from the peripheral area to the spiral side. Wall calcareous, finely perforate.

Sizes —	Maximum diameter	mm 0.65
	Minimum diameter	mm 0.56
	Thickness	mm 0.26

Remarks — The central part of the spiral side is not well visible due to encrusting material. The strong variability observed by Brotzen, is well documented in our specimens.

Occurrence — Known from the Paleocene of Northern Europe and from the Suzak horizon (Paleocene) of the Tajik Depression.

Locality — Barfaq section. Level 61 AE-100/3.

Family Orbitoididae Schwager, 1876

Genus **Orbitoides** d'Orbigny, 1847

Orbitoides media (d'Archiac, 1837)

Pl. 18, fig. 6-7; Pl. 19, fig. 1

1837 *Orbitolites media* d'Archiac. *Cretacé S. O. France*, p. 178.
1920 *Orbitella media* Douvillé. *Révision Orbitoïdes*, p. 215.

1953 *Orbitoides media media* Papp and Küpper. *Orbitoiden Pemberger*, p. 73, pl. 1, fig. 5-7; pl. 2, fig. 2-4.
1954 *Orbitoides media* Küpper. *Orbitoides America*, p. 66, pl. 12, fig. 2-4; text-fig. 2, 8, 11.
1958 *Orbitoides media* Neumann. *Orbitoïdes Aquitaine*, p. 60, pl. 3, fig. 1-6; pl. 5, fig. 3-4; pl. 35, fig. 2; text-fig. 14.

Various nepionts and only occasional axial sections. The material occurs within hard detrital limestones, in which only occasionally complete specimens are encountered.

Embryonic apparatus, mostly quadrilocular, are sectioned in various directions.

Equatorial section: thick walled embryo, with protostolon and deuterostolon clearly visible. Both auxiliary and equatorial chambers have a low arched shape with somewhat thickened walls.

Axial section: embryo trilocular, followed by equatorial chambers initially half-moon shaped, thence tending to become subrectangular. Height of the chambers steadily but slowly increasing. Diagonal stolons not always visible. Lateral chambers in numerous layers but poorly developed, as fissures and with rather thick walls. The pillars, which may cross the whole thickness of the lateral chambers, are clearly evident.

Sizes —	Diameter	mm 2.6	
	Thickness	mm 0.5	
	Proloculus	diameter	mm 0.25 x 0.35
		wall	mm 0.03 to 0.07
		stolon	mm 0.02

The forms encountered correspond rather well to the type, and their identification is beyond doubt.

Occurrence — According to van Hinte (1966), *Orbitoides media* is limited to the Campanian.

Locality — Baba Darves section. Level 61 AD-30.

Family Lepidorbitoididae Pokorny, 1958

Genus **Orbitocyclina** Vaughan, 1929

Orbitocyclina minima (Douvillé, 1923)

Pl. 19, fig. 2-5

1923 *Lepidorbitoides minima* Douvillé. *Orbitoïdes Mexique*, p. 34, fig. 1-2.
1929 *Orbitocyclina minima* Vaughan. *Orbitocyclina*, p. 171.
1938 *Orbitocyclina minima* de Cizancourt. *Remarques Orbitocyclina*, p. 645, pl. 38, fig. 1-9.

Variously oriented sections, often oblique and with parts destroyed, are enclosed in compact limestones.

Shape generally lenticular-discoidal, sometimes asymmetrical.

Equatorial section: embryo bilocular, surrounded by thickened wall, contained in the equatorial plane, and consisting of protoconch and deuteroconch, both almost isodiametric.

A single auxiliary chamber exists from which originate two spirals. The protoconch and deuteroconch are connected in the middle part by means of a protostolon, only rarely visible, slightly aligned towards the opposite side with respect to the deuterostolon.

Equatorial chambers, arranged in spirals, largely arcuate for about half of the shell, thence tending to become more and more elongate and becoming spatulate towards the periphery: their dimensions undergo a moderate increase. The wall is characteristically thickened and is crossed by numerous pores. The communication between the equatorial chambers is realized by means of diagonal stolons in the nepiont and in the first part of the neanic stage; in adult individuals an annular stolon is present for each chamber and results in a communication between chambers belonging to different series.

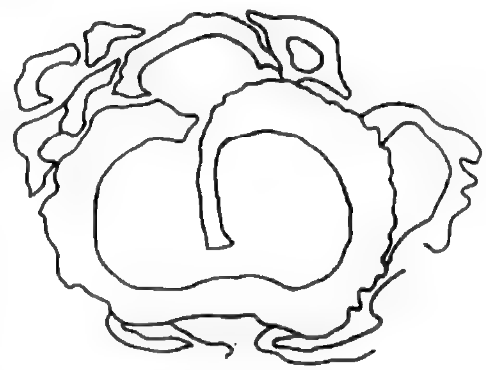


Fig. 1 - Section through the embryonic apparatus of *Orbitocyclina minima* (Douvillé). Baba Darves section, level 61 AD-30/3'; × 120.

Axial section: the dimensions of the equatorial chambers undergo a considerable increase. The height doubles and sometimes triples between the start of the neanic stage and the periphery. The chambers are subquadrate in shape towards the periphery.

On both sides various layers of lateral chambers are present which communicate with one another and with the equatorial chambers by means of well visible pores. Numerous small pillars cross the layers of the lateral chambers, sometimes for all their thickness.

Sizes —	Diameter		mm 4.5 to 5
	Thickness		mm 0.4 to 1
	Chambers	height max.	mm 0.10
		width	mm 0.05 to 0.09
		wall	mm 0.01 to 0.02
	Protoconch	diameter	mm 0.065/0.12 x 0.11/0.18
		wall	mm 0.02/0.03

Deuteroconch	diameter	mm	0.14/0.15 x 0.15/0.21
	wall	mm	0.03/0.04
Auxiliary chamber	diameter	mm	0.05/0.06 x 0.06/0.09
	wall	mm	0.01
Protostolon		mm	0.01

Remarks — The specimens from Afghanistan are identical to those collected by de Cizancourt (1938) in adjacent zones.

The generic attribution of the species here considered has on the other hand been the subject of considerable controversy. Papp and Küpper (1953) demonstrated, in their study of material from Austria, that the species of Douvillé had to be included in the genus *Lepidorbitoides*, according to the original designation of the author. Loeblich and Tappan (1964), in the « Treatise on Invertebrate Paleontology », considered *Orbitocyclina* to be a synonym of *Lepidorbitoides*, thus endorsing the work of Papp and Küpper. However, while the « Treatise » was in press, a very comprehensive work by MacGillavry (1963) appeared which disputed the interpretation of Papp and Küpper in that it considered the species « *minima minima* » as identified by these authors to belong substantially to the genus *Lepidorbitoides*, but, emphasized that this form was not identical with that of Douvillé, as illustrated by de Cizancourt. MacGillavry believes *Orbitocyclina* to belong to an evolutive series parallel to that of *Lepidorbitoides*: *Orbitocyclina* possesses a biserial embryo of somewhat primitive type, but coexists with highly evolute forms including *Lepidorbitoides socialis*, which is to be considered the final stage of the same evolutive series.

Hanzawa (1962, 1964), in his revision of the large trilamellar Cretaceous-Tertiary Foraminifera, distinctly separates *Orbitocyclina* from *Lepidorbitoides*. The two genera have different juvenile stages; in the first, the two series of chambers start from a single auxiliary chamber in opposite directions, until converging in the symmetrical interauxiliary chamber along the wall of the protoconch on one side, and of the deuteroconch on the other. In *Lepidorbitoides* the two series start from two distinct auxiliary chambers and converge in the symmetrical interauxiliary chamber only along the proloculus.

To this fundamental difference others of lesser taxonomic value may be added which nevertheless point to the separation of the two genera.

Occurrence — In addition to Afghanistan, the considered species is distributed in India, Iraq, Jugoslavia, Sicily, Mexico, Cuba, and Florida, in all cases in the Maastrichtian.

Locality — Baba Darves section (level 61 AD-30/3 and /5). North-West of Baba Darves (sample 61 AD-35/1).

Superfamily Cassidulinacea

Family Caucasinidae Bykova, 1959

Subfamily Virgulininae Cushman, 1927

Genus **Virgulina** d'Orbigny, 1826

Virgulina (?) **dibollensis** Cushman & Applin, 1926

Pl. 21, fig. 3

1926 *Virgulina dibollensis* Cushman and Applin. *Texas Jack. Foram.*, p. 168, pl. 7, fig. 7.

Shell narrow and elongate, flattened, with rounded periphery. The early part, irregularly wound, is somewhat reduced (about 1/5 of the whole shell); the biserial portion consists of four pairs of alternate chambers, separated by well-defined sutures, only slightly depressed in the final part, straight, and meeting at precise angles. Chambers initially subrectangular, longer than high, the last pair becoming higher.

The rotation of the axis is somewhat accentuated in the early portion, almost non-existent in the biserial part. Wall calcareous finely perforate. Aperture elongate elliptical, extending on to the apertural face from the base of the final chamber, parallel to the compression.

Sizes — Length mm 0.29
Width mm 0.125

Rare specimens have been attributed with some assurance to the form of Cushman and Applin.

Remarks on the generic position — In the descriptions of the species of Cushman and Applin, and of the subspecies of Bandy (1949) *Virgulina dibollensis subtransversalis*, an initial spiral or triserial coiling is evident. According to the diagnosis of the genus *Virgulina* ([1]), both of the forms under examination should be excluded from the genus itself, since their coiling is biserial throughout. The forms with initial triserial coiling would fall in the genus *Cassidella* Hofker, 1951, validated by Loeblich and Tappan (1964). In view of the scarcity and imperfect state of preservation of the material under examination, it is however preferred to leave the decision open, expressing the doubt about the generic position of the taxon considered by means of a question mark.

Virgulina dibollensis differs from the subspecies *subtransversalis* Bandy in having a less twisted axis and lesser number of chambers in the biserial portion. It differs from *Virgulina yazooensis* Cushman & Todd in having a larger number

---

([1]) = ***Fursenkoina*** in Loeblich and Tappan (1964).

of chambers, in lacking depressed sutures and in having swollen and more elongate chambers.

Occurrence — The type comes from the Upper Eocene of Texas.

Locality — Tashkurgan section. Level 61 AD-59/3.

Virgulina schreibersiana Cžjžek, 1848

1848 *Virgulina schreibersiana* Cžjžek. *Foram. Wiener Beckens*, p. 147, pl. 13, fig. 18-21. (Fide Ellis & Messina).

1953b *Virgulina schreibersiana* Subbotina. *Lagenidae and Buliminidae*, p. 218, pl. 10, fig. 3.

Rare specimens correspond to this well-documented species. However they have a lesser number of chambers than does the type and consequently the forms are less slender.

Sizes — Length mm 0.29
Width mm 0.10

Occurrence — Recorded throughout the world from the older Tertiary onwards.

Locality — Barfaq section. Level 61 AE-100/3.

Family Nonionidae Schultze, 1854

Subfamily Chilostomellinae Brady, 1881

Genus **Allomorphina** Reuss, 1849

Allomorphina conica Cushman & Todd, 1949

Pl. 23, fig. 1 a-c

1949 *Allomorphina conica* Cushman and Todd. *Allomorphina and Quadrimorphina*, p. 62, pl. 11, fig. 8.

1962 *Allomorphina conica* Hillebrandt. *Palaeozän Salzburg*, p. 90, pl. 6, fig. 21 a-b.

Shell trochospiral with the initial part strongly elevated, consisting of 3 whorls with 3 chambers in each whorl. The chambers are very slowly increasing in size in the initial part; the last whorl is 3 times larger than the preceding one. Sutures depressed throughout, strongly depressed in the last whorl. Aperture small, slit-like at the base of last chamber, in correspondence of the suture between the two preceding chambers. Wall calcareous finely perforate.

Sizes —	Length	mm 0.31
	Width	mm 0.32
	Thickness	mm 0.31

Occurrence — Upper Cretaceous and Paleocene of Europe and Central America.

Locality — Barfaq section. Level 61 AE-100/3.

Family ALABAMINIDAE Hofker, 1951

Genus **Gyroidina** d'Orbigny, 1826

Gyroidina aff. **angustiumbilicata** Ten Dam, 1944

Pl. 21, fig. 10 a-c

Test trochospiral, plano-convex, with the umbilical side strongly convex. Equatorial periphery rounded, axial periphery subacute. Shell consisting of 2-2½ whorls, with the inner whorl tighly coiled. Only 9 chambers, very gradually increasing, subrectangular to subquadrate, of the last whorl are clearly visible. The final chamber is gently rounded, the other ones flattened. Spiral suture slightly depressed, sutures between the chambers distinct but flush, except between the last ones where they are slightly deep. On the umbilical side, the height of the chambers increases very rapidly. Chambers triangular in shape with sutures straight, flush with the surface, very slightly depressed around the umbilicus, which is narrow and deep. Aperture a narrow slit at the base of the last chamber, extraumbilical in position. Wall calcareous smooth.

Sizes —	Maximum diameter	mm 0.47
	Minimum diameter	mm 0.44
	Thickness (end)	mm 0.34
	(initial)	mm 0.17

Remarks — The specimens here described are morphologically very similar to *Gyroidina angustiumbilicata* Ten Dam (Fide Ellis & Messina). However, the specimens here considered are not well preserved, and only 1½ inner whorls are visible, instead of 2 or 2½ as in Ten Dam's species; besides the initial part is not elevated and it cannot be stated whether the characters concerning the umbilical area are the same, since Ten Dam did not give an exhaustive description.

Occurrence — *Gyroidina angustiumbilicata* Ten Dam comes from the Paleocene of Holland.

Locality — Barfaq section. Level 61 AE-100/3.

Family Osangulariidae Loeblich & Tappan, 1964

Genus **Gyroidinoides** Brotzen, 1942

Gyroidinoides scrobiculata (Cushman & Ponton, 1932) non Schwager

Pl. 21, fig. 9 a-c

non 1883 *Anomalina scrobiculata* Schwager. *Foram. Eoc. Aegyptens*, p. 129, pl. 29, fig. 18 a-d.
1932 *Valvulineria scrobiculata* Cushman and Ponton. *Foram. Wilcox Alabama*, p. 70, pl. 9, fig. 5 a-c.

Test trochospiral, plano-convex or slightly biconvex, with major convexity on the umbilical side. Equatorial periphery nearly circular, only very slightly lobate in correspondence of the last chambers; axial periphery subangular. 16 chambers arranged in 2½ whorls, with 9 chambers in the last one, gradually increasing, subtriangular in shape, flattened, except the last, which is slightly inflated and displaced towards the umbilicus. Sutures distinct, slightly oblique, very slightly depressed between the last chambers. Inner whorl little depressed. On the umbilical side, last chambers gently inflated, all subtriangular in shape. Sutures distinct, slightly depressed between the last chambers, gently curved, thick around the umbilicus, which is narrow and deep. Aperture slit-like, extending from the umbilicus to the outer margin. Wall calcareous, finely perforate.

Sizes —	Maximum diameter	mm 0.41
	Minimum diameter	mm 0.32
	Thickness	mm 0.16
	Thickness of last chamber	mm 0.19

Remarks — According to Brotzen (1948, p. 74), the specimen illustrated by Cushman and Ponton by the name of *Valvulineria scrobiculata* belongs to the genus *Gyroidinoides*.

It differs from *Valvulineria ravni* Brotzen by having an open umbilicus and thicker sutures on the umbilical side; from *Gyroidina cetera* Bykova by having a distinct umbilicus, shorter chambers on the umbilical side, and by not having a distinct arched depression on the apertural face.

Occurrence — Lower Eocene of Alabama.

Locality — Ali Abad section. Level 61 AE-91/3.

Gyroidinoides soldanii (d'Orbigny) **octocamerata** (Cushman & Hanna, 1927)

Pl. 23, fig. 4 a-c

1927 *Gyroidina soldanii octocamerata* Cushman and Hanna. *Foram. Eoc. Coalinga*, p. 223, pl. 14, fig. 16-18. (Fide Ellis & Messina).

1953 *Gyroidinoides soldanii octocamerata* Beckmann. *Foram. Barbados,* p. 383, pl. 23, fig. 26.

Shell plano-convex, with flattened dorsal side and strongly convex ventral side. Periphery subrounded, non lobate. Two and a half whorls are visible, with eight chambers, which undergo a very marked increase in dimensions in the final whorl. On the dorsal side are chambers of subrectangular form, separated by gently retroflexed sutures which are only slightly depressed; on the ventral side they are of triangular form and separated by slightly depressed radial sutures. The height of the chambers on the ventral side grows very rapidly; the final chamber is twice as high as the first one in the final whorl. Umbilicus rather narrow, filled with material of secondary origin. Apertural face straight; aperture slit-like, at the base of the last chamber. Wall calcareous finely perforate.

Sizes —	Maximum diameter	mm	0.5
	Minimum diameter	mm	0.39
	Thickness (end)	mm	0.27
	(initial)	mm	0.09

Remarks — The specimens investigated correspond well with the forms illustrated by Cushman and Hanna in the Eocene of California.

The present author attributes this form to the genus *Gyroidinoides*, considering the generic attribution given by Beckmann for the Barbados forms to be valid. It is not possible on the basis of the material available to check whether the characters of the umbilical cavity are those of the genus accepted here or those of the genus *Gyroidina*, on account of the filling by secondary calcite.

Occurrence — Frequent in the Eocene of California, Mexico, Barbados, Cuba, Trinidad, and in the Upper Eocene of Ecuador.

Locality — Barfaq section. Level 61 AE-100/3.

Family ANOMALINIDAE Cushman, 1927

Subfamily ANOMALININAE Cushman, 1927

Genus **Anomalina** d'Orbigny, 1826

Anomalina toddae Harris & Jobe, 1951

Pl. 21, fig. 12 a-c

1951 *Anomalina toddae* Harris and Jobe. *Midway Arkansas,* p. 51, pl. 10, fig. 8-9. (Fide Ellis & Messina).

Test equally biconvex, nearly planispiral, practically involute, subovoide in shape. Equatorial periphery not lobate, axial periphery subacute. 8 chambers in the last whorl, subtriangular in shape, gradually increasing in size; the last three chambers are inflated and make up half of the whole test. Sutures rather indistinct, gently curved, slightly depressed between the final two or three chambers. On the spiral side, the initial whorl is strongly depressed; on the umbilical side, umbilicus very small partially closed by a thickened ring. Aperture a low rimmed arch straddling the periphery and extending towards the umbilicus, at the base of the last chamber. Wall calcareous, distinctly perforate.

Sizes —	Maximum diameter	mm 0.42
	Minimum diameter	mm 0.32
	Thickness (end)	mm 0.21
	(initial)	mm 0.11

Rare specimens very typical.
Occurrence — The holotype comes from the Paleocene of Arkansas.
Locality — Ali Abad section. Level 61 AE-91/3.

Genus **Karreria** Rzehak, 1891

Karreria fallax Rzehak, 1891

Pl. 22, fig. 8 a-c, 9 a-c, 10 a-c

1891 *Karreria fallax* Rzehak. *Foram. Altert. Bruderndorf*, p. 6. (Fide Ellis & Messina).
1895 *Karreria fallax* Rzehak. *Foram. österreich. Tertiär*, p. 226, pl. 7, fig. 7-8. (Fide Ellis & Messina).
1927 *Karreria fallax* Franke. *Paläocäns Jütland*, p. 40, pl. 4, fig. 7.
1948 *Karreria fallax* Brotzen. *Swedish Paleocene*, p. 115, pl. 18, fig. 3; text-fig. 34-37.
1961 *Karreria fallax* Vassilenko. *Foram. Mangjshlak*, p. 144, pl. 29, fig. 5; pl. 30, fig. 1-4; pl. 31, fig. 1-2.
1965 *Karreria fallax* Pozaryska. *Biostrat. Dan. Mont. Poland*, p. 138, pl. 19, fig. 3-4.

Numerous specimens correspond well with the type. The exhaustive description of the genus and species under discussion, as made by Brotzen in 1948, has permitted the identification of both of the generations.

The microspheric generation is decidedly more frequent than the megalospheric one, which is, however, always present. The specimens collected by the present worker largely cover the wide variability of the species, particularly among forms B. It is in fact possible to have specimens with the shell completely coiled, and shells with the rectilinear portion well developed. The most common forms are those the spiral portion of which is followed by 2 or 3 chambers in uniserial arrangement.

The wall is calcareous and finely perforate. Aperture terminal, usually semicircular and arcuate, with slightly pronounced toothplate. Supplementary apertures are not observed.

The dimensions are very variable; from 0.44 mm to 1.0 mm length and from 0.31 mm to 0.56 mm breadth.

Occurrence — Form generally recorded in the Danian and in the Paleocene of Northern Europe (Denmark, Switzerland etc.), and common in the Dano-Montian of Poland. It has been found in the Mangjshlak peninsula in Upper Maastrichtian-Danian and Lower Paleocene; in the Precaspic Depression, in Crimea, North-West Caucasus, in the Lower Paleocene of the Carpathians and in the Upper Paleocene of Turkmenistan and in the Tajik Depression.

Locality — Barfaq section. Level 61 AE-100/3.

Selected Bibliography

Bandy O. L., 1949 — *Eocene and Oligocene Foraminifera from Little Stave Creek, Clarke County, Alabama*. Bull. Amer. Pal., vol. 32, n. 131, pp. 5-211, 2 fig., 27 pl., Ithaca.

Beckmann J. P., 1953 — *Die Foraminiferen der Oceanic Formation (Eocaen-Oligocaen) von Barbados, Kl. Antillen*. Ecl. Geol. Helv., vol. 46, n. 2, pp. 301-412, 29 fig., 1 tab., 15 pl., Basel.

Beckmann J. P., 1957 — *Chiloguembelina Loeblich and Tappan and related Foraminifera from the Lower Tertiary of Trinidad, B.W.I.* U.S. Nat. Mus. Bull., n. 215, pp. 83-95, fig. 14-16, pl. 21, Washington.

Blow W. H., Banner F. T., 1962. In: Eames F. E., Banner F. T., Blow W. H., Clarke W. J. — *Fundamentals of Mid-Tertiary stratigraphical correlation*. Vol. of 163 pp., 20 fig., 17 pl., University Press, Cambridge.

Bolli H. M., 1957 — *The genera Globigerina and Globorotalia in the Paleocene-Lower Eocene Lizard Springs formation of Trinidad, B.W.I.* U.S. Nat. Mus. Bull., n. 215, pp. 61-82, 3 fig., pl. 15-20, Washington.

Bolli H. M., Cita M. B., 1960 — *Globigerine e Globorotalie del Paleocene di Paderno d'Adda (Italia)*. Riv. It. Pal. Strat., vol. LXVI, n. 3, pp. 361-408, 2 fig., pl. 33-35, Milano.

Brotzen F., 1946 — *The Swedish Paleocene and its foraminiferal fauna*. Sver. Geol. Unders., s. C., n. 493, pp. 1-140, 41 fig., pl. 1-18, Stockholm.

Bogdanovich A. K., 1950 — *Chokrak Foraminifera of western Ciscaucasia*. Tr. VNIGRI, vol. 51, Microfauna USSR, t. 4, pp. 129-176, 10 pl., Leningrad. (In russian).

Bykova N. K., 1953 — *Foraminifera of the Suzakian stage of the Tajikistan Basin*. Tr. VNIGRI, vol. 69, Microfauna USSR, t. 6, pp. 3-114, 13 fig., 9 tab., pl. 1-5, Leningrad. (In russian).

Bykova N. K., 1959 — *Contributions on paleoecology of Foraminifera from the Alai and Turkestan stages (Paleogene of Ferghana Valley)*. Tr. VNIGRI, vol. 136, Microfauna USSR, t. 10, pp. 544-597, 2 fig., 4 tab., pl. 1-5, Leningrad. (In russian).

Charollais J., Brönnimann P., 1965 — *Première note sur les Foraminifères du Crétacé inférieur de la région genevoise. Sabaudia Charollais et Brönnimann, n. gen.* Arch. Sc., vol. 18, fasc. 3, pp. 615-624, 4 fig., 3 pl., Genève.

CHAROLLAIS J., BRÖNNIMANN P., ZANINETTI L., 1966 — *Troisième note sur le Foraminifères du Crétacé inférieur de la région genevoise. Remarques stratigraphiques et description de Pseudotextulariella salevensis, n. sp.; Haplophragmoides joukowskyi, n. sp.; Citaella ? favrei, n. sp.* Arch. Sc., vol. 19, pp. 23-48, 6 fig., 5 pl., Genève.

CHIOCCHINI M., DI NAPOLI ALLIATA E., 1966 — *Sulla presenza di « Textulariella minuta » Hofker e « Textulariella auruncensis » n. sp. (Foraminiferida) nel Cretacico inferiore dei Monti Aurunci (Lazio meridionale).* Boll. Serv. Geol. Ital., vol. LXXXVII, pp. 1-13, 2 fig., 7 pl., Roma.

CITA M. B., PREMOLI SILVA I., 1970 — *Micropaleontological notes on some Cretaceous-Eocene sections in North-Eastern Afghanistan.* (In press).

CITA M. B., RUSCELLI M. A., 1959 — *Cretaceous microfacies from West Pakistan and Afghanistan.* Riv. It. Pal. Strat., vol. LXV, n. 3, pp. 231-244, 1 fig., 6 pl., Milano.

COLE W. S., 1927 — *A foraminiferal fauna from the Guayabal formation in Mexico.* Bull. Amer. Pal. vol. 14, n. 51, pp. 1-46, pl. 1-5, Ithaca.

CUSHMAN J. A., APPLIN E. R., 1926 — *Texas Jackson Foraminifera.* Amer. Ass. Petr. Geol. Bull., vol. 10, pt. 1, pp. 154-189, pl. 6-10, Tulsa.

CUSHMAN J. A., EDWARDS P. G., 1937 — *The described American Eocene species of Uvigerina.* Contr. Cush. Lab. Foram. Res., vol. 13, pt. 3, pp. 74-87, pl. 11-12, Sharon.

CUSHMAN J. A., JARVIS P. W., 1929 — *New Foraminifera from Trinidad.* Contr. Cush. Lab. Foram. Res., vol. 5, pt. 1, pp. 6-17, pl. 2-3, Sharon.

CUSHMAN J. A., PONTON G. M., 1932 — *An Eocene foraminiferal fauna of Wilcox age from Alabama.* Contr. Cush. Lab. Foram. Res., vol. 8, pt. 3 & 4, pp. 51-72, pl. 7-9, Sharon.

CUSHMAN J. A., RENZ H. H., 1942 — *Eocene, Midway, Foraminifera from Soldado Rock, Trinidad.* Contr. Cush. Lab. Foram. Res., vol. 18, pt. 1, pp. 1-14, pl. 1-3, Sharon.

CUSHMAN J. A., TODD R., 1949 — *Species of the genera Allomorphina and Quadrimorphina.* Contr. Cush. Lab. Foram. Res., vol. 25, pt. 3, pp. 59-72, pl. 11-12, Sharon.

CUVILLIER J., SZAKALL V., 1949 — *Foraminifère d'Aquitaine. (Reophacidae à Nonionidae).* Vol. of 112 pp., 32 pl., Ed. Boisseau F., Toulouse.

D'ARCHIAC A., 1837 — *Mémoire sur la formation crétacée du sudouest de la France.* Mém. Soc. Géol. France, t. 2, n. 7, pp. 157-192, pl. 11-13, Paris.

DAVIDSON R. M., MOROZOVA V. G., 1964 — *Planktonic and benthonic calcareous Foraminifers of the Bukhara Beds (Paleocene) in Tajik depression.* Paleont. Zhurn., n. 3, pp. 23-29, 1 fig., 2 pl., Moscow. (In russian).

DE CIZANCOURT H., 1938 — *Remarques sur le genre Orbitocyclina Vaughan.* Bull. Soc. Géol. France, s. 5, vol. 8, n. 7-8, pp. 645-652, 2 fig., pl. 38, Paris.

DE LAPPARENT A. F., 1963 — *La série stratigraphique de la vallé de Kahmard (Hindou Kouch, Afghanistan).* C.R. Acad. Sc., t. 256, pp. 2646-2648, Paris.

DESIO A., MARTINA E., PASQUARÈ G., 1964 — *On the Geology of Central Badakhshan.* Quart. Journ. Geol. Soc. London, vol. 120, pp. 127-151, 3 fig., London.

D'ORBIGNY A., 1826 — *Tableau méthodique de la classe des Céphalopodes.* Ann. Sc. Nat., s. 1, t. 7, pp. 96-314, pl. 10-17, Paris.

D'ORBIGNY A., 1840 — *Mémoires sur les Foraminifères de la craie blanche du bassin de Paris.* Mém. Soc. Géol. France, n. 4, pt. 1, pp. 1-51, 4 pl., Paris.

D'ORBIGNY A., 1846 — *Foraminifères fossiles du bassin tertiaire de Vienne.* Vol. of 303 pp., 21 pl., Gide et Comp., Paris.

DOUVILLÉ H., 1920 — *Révision des Orbitoïdes.* 1ère partie: *Orbitoïdes crétacés et genre Omphalocyclus.* Bull. Soc. Géol. France, s. 4, t. 20, pp. 209-232, 37 fig., pl. 8, Paris.

Douvillé H., 1927 — *Les Orbitoïdes de la région pétrolifère du Mexique*. C.R.S.S. Soc. Géol. France, n. 4, pp. 34-35, Paris.

Ellis B. F., Messina A. R., 1940-1968 — *Catalogue of Foraminifera*. Amer. Mus. Nat. History, New York.

Franke A., 1927 — *Die Foraminiferen und Ostrakoden des Paläocäns von Rugaard in Jütland und SundKrogen bei Kopenhagen*. Danm. Geol. Unders., R. 2, n. 46, pp. 1-49, 4 pl., Kopenhagen.

Gekker R. T., Osipova A. I., Belskaya T. N., 1962 — *Ferghana Gulf of Paleogene Sea of Central Asia. Its history, sediments, fauna and flora, their environment and evolution*. Ak. Nauk USSR, Paleont. Inst., pt. 2, pp. 1-331, 70 fig., 3 tab., pl. 1-27, Moscow. (In russian).

Glaessner M. A., 1937 — *Studien über Foraminiferen aus der Kreide und dem Tertiär des Kaucasus*. Problems Paleont., vol. 2-3, pp. 349-410, pl. 1-5, Moscow.

Gohrbandt K., 1963 — *Zur Gliederung des Paläogen im Helvetikum nördlich Salzburg nach planktonischen Foraminiferen*. Mitt. Geol. Gesell. Wien, Bd. 56, H. 1, pp. 1-116, 7 fig., pl. 1-11, Wien.

Hagn H., Lindenberg H. G., 1969 — *Revision der von C. W. Gümbel 1868 aus dem Eozän des Bayerischen Alpenvorlandes beschrieben planktonischen Foraminiferen*. Proc. I Inter. Plankt. Conference, vol. II, pp. 229-249, 6 fig., Ed. Brill, Leiden.

Hantken M., 1875 — *Die Fauna der Clavulina szaboi Schichten*. Mitt. Jahr. Kön. Ungar. Geol. Anst., Bd. 4, H. 1, pp. 1-93, 16 pl, Budapest.

Hanzawa S., 1962 — *Upper Cretaceous and Tertiary three-layered larger Foraminifera and their allied forms*. Micropaleontology, vol. 8, n. 2, pp. 129-186, pl. 1-8, New York.

Hanzawa S., 1964 — *The Ontogeny and Evolution of Larger Foraminifera*. Sci. Rep. Tohoku Univ., Geol., vol. 36, n. 2, pp. 239-256, 1 tab., pl. 30-40, Sendai.

Henson F. R. S., 1948a — *Larger imperforate Foraminifera of South-Western Asia*. Brit. Mus. Nat. Hist., pp. 1-127, 16 fig., 16 pl., London.

Henson F. R. S., 1948b — *New Trochamminidae and Verneuilinidae from the Middle East*. Ann. Mag. Nat. Hist., s. 11, vol. 14, pp. 605-630, 5 pl., London.

Hillebrandt v. A., 1962 — *Das Paleozän und seine Foraminiferenfauna im Becken von Reichenall und Salzburg*. Abh. Bayer. Ak. Wissen., Math.-Nat. Kl., N.F., H. 108, pp. 1-182, 12 fig., 15 pl., München.

Hinte J. E. van, 1966 — *Orbitoides from the Campanian type section*. Kon. Ned. Ak. Wetensch., Proc. B, vol. 69, n. 1, pp. 79-110, 14 fig., 18 tab., Amsterdam.

Hofker J., 1951 — *The Foraminifera of the Siboga Expedition*. Pt., 3, pp. 1-513, 348 fig., Ed. J. Brill, Leiden.

Hofker J., 1957 — *Foraminifera from the Cretaceous of Southern Limburg, Netherlands, XXVII. On Karreria fallax Rzehak*. Natuurhist. Maandbl., n. 7-8, pp. 98-100, 2 fig., The Hague.

Hofker J. jr., 1965 — *Some Foraminifera from the Aptian-Albian passage of Northern Spain*. Leids. Geol. Medel., vol. 33, pp. 183-189, 2 fig., 5 pl., Leiden.

Hottinger L., 1967 — *Foraminifères imperforés du Mésozoïque marocain*. Notes Mém. Serv. Géol. Maroc, n. 209, pp. 1-168, 61 fig., 20 pl., Rabat.

Kaever M., 1963 — *Das Hadjar-Kreide-Tertiär-Profil und seine Stellung in der Ober-Kreide Zentral-Afghanistans*. N. Jahrb. Geol. Pal. Mon., n. 12, pp. 669-677, 2 fig., Stuttgart.

Kaever M., 1965a — *Biostratigraphische Gliederung eines Tertiär-Profils im nordwestlichen*

Hindu-Kush-Vorland und Vergleiche mit anderen Tertiär-Vorkommen in Afghanistan. N. Jahrb. Geol. Pal. Mon., n. 8, pp. 481-495, 2 fig., Stuttgart.

KAEVER M., 1965b — *Mikropalaeontologische Untersuchungen zur Stratigraphie Afghanistans.* Erdöl. u. Koh. Erdgas-Petroch., Bd. 18, n. 9, 7 pp., 1 pl., Hamburg.

KÜPPER K., 1954 — *Notes on Cretaceous Larger Foraminifera. I. Genus Orbitoides in America.* Contr. Cush. Found. Foram. Res., vol. 5, pt. 2, pp. 63-67, 2 fig., pl. 12, Washington.

KURGALIMOVA G. G., 1967 — *Stratigraphy and facies of the middle and upper Eocene deposits from Eastern Pre-Aral and Northern Kyzyl Kum based on the foraminiferal fauna.* BMOIP, Geol. Serv., vol. 42, n. 4, pp. 38-46, 5 fig., Moscow. (In russian).

LOEBLICH A. R. jr., TAPPAN H., 1957 — *Planktonic Foraminifera of Paleocene and early Eocene age from the Gulf and Atlantic Coastal Plains.* U.S. Nat. Mus. Bull., n. 215, pp. 173-198, 2 fig., pl. 40-64, Washington.

LOEBLICH A. R. jr., TAPPAN H., 1964 — In: MOORE: *Treatise on Invertebrate Paleontology.* Protista, 2, pp. 1-900, 653 fig., Univ. Kansas Press and Geol. Soc. Amer., Lawrence.

MACGILLAVRY H. J., 1963 — *Phylomorphogenesis and evolutionary Trends of Cretaceous Orbitoidal Foraminifera.* In: Evolutionary Trends in Foraminifera, pp. 139-197, 9 fig., 4 tab., 8 pl., Elsevier Publ. Co., Amsterdam.

MARKS P., 1962 — *Variation and evolution in Orbitoides from the Cretaceous of the Rakhi Nala, West Pakistan.* Geol. Bull. Panjab Univ., n. 2, pp. 15-30, 6 fig., 4 tab., Lahore.

MASLAKOVA N. I., 1955 — *Stratigraphy and smaller Foraminifera fauna from the Paleogene deposits of Eastern Carpathian.* In: Contributions to the biostratigraphy of the western regions of Ukraina SSR. Gosgeoltekhizdat, pp. 1-130, 11 fig., pl. 1-17, Moscow. (In russian).

MOROZOVA V. G., KOZHEVNIKOVA G. E., KURYLEVA A. M., 1967 — *Danian-Paleocene heterofacial deposits of Kopet-Dag and methods of their correlation according to Foraminifers.* Ak. Nauk USSR, Geol. Inst., v. 157, pp. 1-211, 6 fig., 21 tab., 7 pl., Moscow. (In russian).

MOROZOVA V. G., KREIDENKOV G. P., DAVIDSON R. M., 1965 — *Biostratigraphy of the Paleocene deposits in the Tajikistan depression.* BMOIP, Geol. Ser., vol. 40, n. 3, pp. 34-56, 2 fig., 3 tab., Moscow. (In russian).

MUNIER-CHALMAS E., 1887 — *Sur la Cyclolina et trois nouveaux genres de foraminifères de couches à Rudistes: Cyclopsina, Dicyclina et Spirocyclina.* C.R.S.S. Soc. Géol. France, t. 7, pp. 30-31, Paris.

NEUMANN M., 1958 — *Révision des Orbitoïdes du Crétacé et de l'Eocène en Aquitaine Occidentale.* Mém. Soc. Géol. France, n. 83, pp. 1-174, 54 fig., pl. 1-34, Paris.

OSIMO G., 1907 — *Il genere « Siderolites » Lamk.* Atti R. Accad. Sc. Torino, vol. 42, pp. 273-285, 1 pl., Torino.

PAPP A., KÜPPER K., 1953 — *Die Foraminiferenfauna von Guttaring und Klein St. Paul. II: Orbitoiden aus Sandsteinen von Pemberger bei Klein St. Paul.* Sitzber. Österr. Ak. Wiss., Math.-Nat. Kl., Abt. 1, Bd. 162, pp. 273-277, 3 pl., Wien.

PLUMMER H. J., 1926 — *Foraminifera of the Midway Formation in Texas.* Univ. Texas Bull., n. 2644, pp. 1-206, pl. 1-15, Austin.

POZARYSKA K., 1965 — *Foraminifera and biostratigraphy of the Danian and Montian in Poland.* Palaeont. Polonica, n. 14, pp. 1-156, pl. 1-28, Warzawa.

RADOIČIĆ R., 1960 — *Microfacies du Crétacé et du Paléogène des Dinarides externes de Yougoslavie.* Inst. Rech. Géol. R. P. and CRNA GORA, vol. of 172 pp., 67 pl., Titograd.

Reiss Z., Merling P., 1958 — *Structure of some Rotaliidea.* Bull. Geol. Surv. Israel, n. 21, pp. 1-29, 5 pl., Jerusalem.

Samoilova R. B., 1947 — *New and characteristic foraminiferal species from the upper Paleogene of Crimea.* BMOIP, n.s., Geol. Ser., vol. 22, pt. 4, pp. 77-101, Moscow. (In russian).

Saperson E. I., 1964 — *Biostratigraphy of the Paleocene and Eocene deposits of Northern Turkmenia based on Foraminifera.* VSEGEI, pp. 1-20, 3 tab., Leningrad. (In russian).

Sartoni S., Crescenti U., 1962 — *Ricerche biostratigrafiche nel Mesozoico dell'Appennino Meridionale.* Giorn. Geol., s. 2, vol. 29, pp. 159-302, 42 pl., Bologna.

Schlumberger C., Choffat P., 1904 — *Note sur le genre Spirocyclina Munier-Chalmas et quelques autres genres du même auteur.* Bull. Soc. Géol. France, s. 4, t. 4, pp. 358-368, 3 fig., 2 pl., Paris.

Schmid E. M., 1962 — *Die Foraminiferenfauna des Bruderndorfer Feinsandes (Danien) von Haidhof bei Ernstbrunn, NÖ.* Sitzber. Österr. Ak. Wiss., Math.-Nat. Kl., Bd. 171, H. 8/10, pp. 315-361, 7 pl., Wien.

Shutzkaja E. K., 1965 — *Filogenetic connections between the species of Globorotalia compressa Plummer group into the Danian and Paleocene.* Vopr. Micropal., vol. 9, pp. 173-188, 1 pl., 5 fig., Moskow. (In russian).

Shutzkaja E. K., Schvemberger Ju. N., Khasina G. I., 1965 — *Globorotaliae from the Upper Paleocene and Lower Eocene deposits of Crimea, Prae-Caucasus and Ultra-Caspian.* Tr. VNIGNI, vol. 44, pp. 192-211, pl. 1-4, Moscow. (In russian).

Schwager C., 1883 — *Die Foraminiferen aus den Eocaenablagerungen der libyschen Wüste und Aegyptens.* Palaeontographica, Bd. 30, T. 1, pp. 79-153, pl. 1-6, Cassel.

Smout A. H., 1954 — *Lower Tertiary Foraminifera of the Qatar Peninsula.* British Mus. Nat. Hist., pp. 1-96, 44 fig., 15 pl., London.

Subbotina N. N., 1947 — *Les Foraminifères des dépôts du Danien et du Paléogène du Caucase septentrional.* Tr. VNIGRI, Microfauna of the Caucasus, Emba and Central Asia, pp. 36-160, 8 tab., 9 pl., Leningrad. (Trad. BRGM in french n. 2503).

Subbotina N. N., 1953a — *Globigerinidae, Hantkeninidae and Globorotaliidae.* Tr. VNIGRI, vol. 76, pp. 1-239, 8 fig., 3 tab., 41 pl., Leningrad. (In russian).

Subbotina N. N., 1953b — *Upper Eocene Lagenidae and Buliminidae of the Southern USSR.* Tr. VNIGRI, vol. 69, Microfauna USSR, t. 6, pp. 115-225, 1 tab., pl. 1-13, Leningrad. (In russian).

Vassilenko V. P., 1961 — *Upper Cretaceous Foraminifera from the Mangjshlak.* Tr. VNIGRI, vol. 171, pp. 1-487, 40 fig., 15 tab., 41 pl., Leningrad. (In russian).

Vaughan T. W., 1929 — *Species of Orbitocyclina, a genus of American Orbitoid foraminifera from the Upper Cretaceous of Mexico and Louisiana.* Journ. Paleont., vol. 3, n. 2, pp. 170-175, pl. 22, Menasha.

White M. P., 1928 — *Some index foraminifera of the Tampico embayment area of Mexico.* Journ. Paleont., vol. 2, pp. 177-215, pl. 27-29; pp. 280-317, pl. 38-42, Menasha.

PALEOGENE PELECYPODS FROM KATAGHAN AND BADAKHSHAN

by

ADELE BERIZZI QUARTO DI PALO

Assistant at the Institute of Paleontology of the Milan University

INTRODUCTION

The paleontological material dealt with in present paper was collected in 1961 in North-Eastern Afghanistan during a scientific expedition in that region sponsored by the C.N.R. and carried out by Professor Ardito Desio (past Director of the Institute of Geology at the University of Milan) in conjunction with dr. Ercole Martina and dr. Giorgio Pasquaré.

The abundant macrofossils collected in the Kataghan and Badakhshan regions were entrusted for study to Professor Carla Rossi Ronchetti, Director of the Institute of Paleontology at the University of Milan. They are Paleogene fossils, largely Eocene, and are all Pelecypods; a few are of Oligocene age. They are housed in the Institute of Paeontology at the University of Milan.

Grateful thanks are due to Professor Carla Rossi Ronchetti for her advice during the paleontological study and for the critical assessement of the text, and to Dr. Andrea Allasinaz who has followed the progress of this work throughout. The author is also indebted to Prof. O.S. Vialov for his valuable advice on Ostreids and for sending rare important russian literature.

PREVIOUS WORK

Paleontological studies of the Paleogene of North-Eastern Afghanistan are extremely scanty, and are in effect limited to those of Cox (1938) on the Eocene fauna. In that work Cox presented the results of the study of macrofossils originating from the fossiliferous localities of Turbolak, Zaverzad, Ali Abad, Tashkurgan, Shirbaghan, and Koh-i-Ambar. The fauna was not varied and consisted only of *Ostrea multicostata strictiplicata* Raulin & Delbos, *Ostrea esterhazyi* var. *romanowskii* Böhm, *Ostrea cizancourti* Cox, *Ostrea* cf. *bellovacina* Lamarck, *Ostrea gigantica* Solander, *Meretrix* sp., *Ditrupa plana* Sowerby and *Cardium* sp. Despite this fact, it sufficed for the attribution of the fossiliferous horizons to an age between the Ypresian and Upper Lutetian or Auversian.

In 1954 Popol and Tromp summarized the geological knowledge about Afghanistan, integrating the descriptions with stratigraphical columns and with summary tables. The study of Kaever (1963) was entirely stratigraphical, and related to the Cretaceous-Tertiary section of Hadjar, on which the extent of the Upper Cretaceous of Central Afghanistan is debated.

Some additional interesting paleontological data on the Paleogene of the zone being studied was recently provided by Hinze (1964), in a publication on the geological evolution of the North-Eastern flank of Hindu Kush. From the localities of Ambar Koh, Khanabad, Taluqan, Orte Hazara, Qolug, and Koh-i-Yaka Badam originate several macrofossils identified by the author as: *Gryphaea esterhazyi* Pavay, *G. cizancourti* (Cox), *Liogryphaea cocanensis* (Sokolow), *Ostrea longirostris* Lamarck, *Ostrea* cf. *multicostata* Deshayes, *O. gigantica* Solander. On the basis of these forms, Hinze has dated the fossiliferous horizons to an age between the Suzak Stage and the Turkestan Stage.

In 1964 Desio, Martina and Pasquaré edited a work of predominantly geological character and dealing in particular with the Central Badakhshan region of North-Eastern Afghanistan. This followed the preliminary note of Desio on Afghanistan (1960).

Vialov, Nedelku and Niza (1966) reviewed the available scanty data relating to the Paleogene of Northern Afghanistan and drew some interesting conclusions. From the observation that the Tajik Depression tectonically includes Northern Afghanistan, they deduced that there would be developed in Northern Afghanistan the same type of Paleogene sedimentation, with about the same fauna of Tajikistan, and that the Middle Asia stratigraphical schema would be applied to Afghanistan. Niza and Nedelku in particular have described the series in the vicinity of Shibargan and described the subdivision into beds; Vialov has investigated previous studies of Northern Afghanistan, analysed the fauna and made several correlations. These authors have finally recorded 18 Eocene forms of Afghanistan Pelecypods: *Gari consobrina* Deshayes, *Gryphaea* (*Gryphaea*) *smirnowi lata* Vialov, *G.* (*Phygraea*) *antiqua* ssp. *antiqua* Vialov, *G.* (*Phygraea*) *antiqua* ssp. *korsunensis* Vialov, *Ostrea* (*Cymbulostrea*) *crimensis* (Zubhovitsch), *O.* (*Cymbulostrea*) *multicostata* Deshayes, *O.* (*Cymbulostrea*) sp., *O. hemiglobosa* Romanovskiy, *O. afghanica* Vialov, *O. turkestanensis* Romanovskiy, *O. turkestanensis* var. *baissunensis* Böhm, *O. callipyga* Vialov, *Crassatella bellovacensis* Deshayes, *Corbula* (*Cuneocorbula*) *biangulata* Deshayes, *C.* (*Cuneocorbula*) *triangulata* Vialov, *Cardium* aff. *bonellii* Bellardi, *Cardium* sp., *Pecten* sp. As regard the Oligocene, citations of macrofossils in the literature are negligible.

In the work quoted initially, Cox has affirmed that the formations of North-Eastern Afghanistan comprise the prolongation of that of South-Eastern Turkestan. Because of the scarcity of paleontological data on the Afghan Paleogene, a rapid comparative summary of the works on larger Middle Asia area is given below; both the Eocene and the Oligocene are taken into account.

The Paleogene fauna of South-Eastern Turkestan, which was described for the first time by Romanovskiy (1878-1884), was then the subject of numerous publications by various authors. In 1910, Sokolow, in a résumé of the data on the Ferghanian age, supplied the results of the study of a fauna collected in sediments of this age outcropping in the flanks of the Ferghana Valley, recording as Eocene the following forms: *Platygena asiatica* Romanovskiy, *Ostrea kokanensis* Sokolow, *Gryphaea esterhazyi* Pavay, *Gryphaea romanowskii* Böhm (= *Gryphaea kaufmannii*), *Ostrea turkestanensis* Romanovskiy. For the Oligocene he recorded: *Exogyra ferganensis* Romanovskiy, *Exogyra galeata* Romanovskiy. With this data the author concluded that the Ferghanian age consisted of Tertiary sediments and also fixed for the *Gryphaea esterhazyi* Pavay horizon an age corresponding to the Middle Eocene.

The Paleogene formations of Central Asia contain almost an exclusively Ostreid fauna, the various species of which are abundantly represented. Their importance and their relative stratigraphical position have been the subject of a study by Bornemann, Buracek and Vialov (1934) and subsequently by Vialov alone (1937 a). Publications relating to the stratigraphy of Turkestan have been produced also by Böhm (1933), Vialov (1934-35) and Petrushevskiy (1937). In another publication Vialov (1937 b) examined many Pelecypods originating from the Ferghana basin, classifying the following species as Eocene, subdivided in the Bukhara to Rischtan Stage as follows:

Bukhara stage: *Ostrea kalizkyi* Vialov.

Suzak stage: *Ostrea* aff. *hemiglobosa* Romanovskiy, *O. bellovacina* var. *trinkleri* Böhm, *Gryphaea errara* Vialov.

Alai stage: *Ostrea strictiplicata* Raulin & Delbos, *O. strictiplicata* var. *borgalensis* Vialov, *O. gorizdroae* Vialov.

Turkestan stage: *Ostrea kokanensis* Sokolow, *O. schurabica* Vialov, *Gryphaea esterhazyi* Pavay, *G. beldersaiensis* (Gorizdro), *G. boehmi* Vialov, *G. boehmi transita* Vialov.

Rischtan stage: *Ostrea (Platygena) asiatica* Romanovskiy, *O. simplex* Deshayes.

Vialov has quoted the following forms in the Khanabad and Sumssar stages:

Khanabad stage: *Ostrea plicata* Solander, *O. tianschanensis* Romanovskiy.

Sumssar stage: *Gryphaea sewerzowi* Romanovskiy, *Exogyra ferganensis* Romanovskiy, *E. galeata* Romanovskiy, *E. galeata* var. *rotula* Vialov, *Ostrea flabellulaeformis* Schauroth, *O. pygmaea* Vialov.

Several years later (1948) Vialov examined a fauna from the Tajik Depression in the Eocene beds of which he found the following forms:

Bukhara stage: *Gryphaea (Phygraea) antiqua* (Schwetz).

Suzak stage: *Ostrea (Solidostrea) hemiglobosa* Romanovskiy, *O. (Solidostrea) hemiglobosa kafirniganica* Buracek, *Liostrea (Liostrea) reussi* (Netschaew), *Gryphaea (Biauris) aviculina* Mayer-Eymar, *G. (Circogryphaea) sinzowi* Netschaew, *G. (Gigantostrea) camelus* Buracek, *G. (Gigantostrea) camelus* var. *extensa* Vialov, *G. (Gigantostrea) camelus* var. *angustirostra* Vialov, *G. (Gigantostrea) camelus javanica* Buracek, *G. (Gryphaea) latipyga* Vialov, *G. (Gryphaea) smirnowi* Romanovskiy, *G. (Gryphaea) smirnowi lata* Vialov, *G. (Gryphaea) uncifera* Leymerie, *G. (Phygraea) antiqua* (Schwetz), *G. (Phygraea) tournali* (Doncieux), *G. (Phygraea) tournali circularis* Vialov, *G. (Phygraea) tournali* var. *wakhschensis* Vialov, *Amphidonta (Gryphaeostrea) eversa* (Melleville).

Alai stage: *Ostrea (Cymbulostrea) multicostata* Deshayes, *O. (Cymbulostrea) multicostata* var. *schirabadica* Vialov, *O. (Turkostrea) afghanica* Vialov, *O. (Turkostrea) cizancourti* Cox, *O. (Turkostrea) khaudaguensis* Vialov, *O. (Turkostrea) turkestanensis* Romanovskiy, *O. (Turkostrea) turkestanensis* var. *alaica* Vialov, *O. (Turkostrea) turkestanensis* var. *baissunensis* Böhm, *O. (Turkostrea) turkestanensis* var. *borgalensis* Vialov, *Ostrea* sp.

Turkestan stage: *Ostrea (Flemingostrea) schurabica* Vialov, *Liostrea (Kokanostrea) kokanensis* (Sokolow), *Fatina (Fatina) boehmi boehmi* Vialov, *F. (Sokolowia) esterhazyi* (Pavay) var. *esterhazyi* Vialov, *F. (Sokolowia) esterhazyi* var. *alfa* Vialov.

For the Khanabad and Sumssar stages of Oligocene he recorded:

Khanabad stage: *Ostrea* aff. *cyathula* Lamarck, *O. tianschanensis* Romanovskiy.

Sumssar stage: *Ostrea* (*Cymbulostrea*) *pygmaea* Vialov, *Gryphaea* (*Ferganea*) *sewerzowi* Romanovskiy, *G.* (*Ferganea*) *sewerzowi* var. *sacculus* Romanovskiy.

During the last ten years, studies on these areas have been intensified, providing new stratigraphical and paleontological data.

In 1958 Osipova discussed various questions of the Lower Paleogene stratigraphy of the south-east part of Central Asia. In the following year Chikhachev and Solun (1959) in a work on the sea Tertiary deposits of the Tajikistan made a list of all the forms (micro and macrofossils) present in the series of beds between the Bukhara and Sumssar stages, which correspond to the limits of those previously indicated by Vialov in 1948 for the various stages of the Tajik Depression. In 1962 Gekker, Osipova and Bel'skaya recorded the following Eocene species of *Ostreidae* at Ferghana, subdivided as follows into the respective stages:

Suzak stage: *Ostrea* (*Bellostrea*) *bellovacina* Lamarck, *O.* (*Bellostrea*) *bellovacina trinkleri* Böhm, *O.* (*Bellostrea*) *kalizkyi* Vialov, *O.* (*Solidostrea*) *hemiglobosa kafirniganica* Buracek, *Gryphaea* (*Gigantostrea*) *camelus* Buracek, *G.* (*Gryphaea*) *errara* Vialov.

Alai stage: *Ostrea* (*Gorizdrella*) *gorizdroae* Vialov, *O.* (*Turkostrea*) *turkestanensis* Romanovskiy.

Turkestan stage: *Ostrea* (*Flemingostrea*) *schurabica* Vialov, *Liostrea* (*Kokanostrea*) *kokanensis* (Sokolow), *Fatina esterhazyi* (Pavay).

Rischtan stage: *Ostrea* (*Platygena*) *asiatica* Romanovskiy, *O.* (*Platygena*) *lada* Vialov, *Liostrea rischtanica* Vialov (in litt.).

To this list must be added the Oligocene forms quoted by the authors:

Khanabad stage: *Ostrea* (*Cubitostrea*) *plicata* Solander, *O.* (*Cubitostrea*) *tianschanensis* Romanovskiy, *O.* ex *Gryphaea longirostris* Lamarck.

Sumssar stage: *Ostrea* (*Cymbulostrea*) *flabellulaeformis* Schauroth, *O.* (*Cymbulostrea*) *pygmaea* Vialov, *Gryphaea* (*Ferganea*) *sewerzowi* Romanovskiy, *Amphidonta ferganensis* (Romanovskiy).

The biostratigraphy of Morozova, Kreidenkov and Davidson on the Paleogene of the Tajik Depression, published in 1965, represents the most recent study consulted. These authors record numerous species, both of microfossils and of macrofossils, in the Bukhara and Suzak stages, only a very few of them being present also in North Afghanistan, i.e. *Ostrea hemiglobosa* Romanovskiy, *Gryphaea smirnowi* Romanovskiy.

Recently (1967) Kaever published a critical review of works on Afghan Tertiary.

CRITICAL EXAMINATION OF THE FOSSILIFEROUS LOCALITIES

The localities from which the material under examination originates are all situated in North Afghanistan, in the zone between Tashkurgan and Kalafgan. In particular, the fossils collected at Tashkurgan, to the west of Shiboglu-Kotal, at Ali Abad, in the valley north of Hugi Jangal, at Ambar Koh and at Kalafgan are of Eocene age, whereas those collected east of Shiboglu Kotal, but not in situ, are of Oligocene age.

The fossiliferous localities are dealt with from a critical stratigraphical viewpoint below, in geographical order from west to east and from north to south.

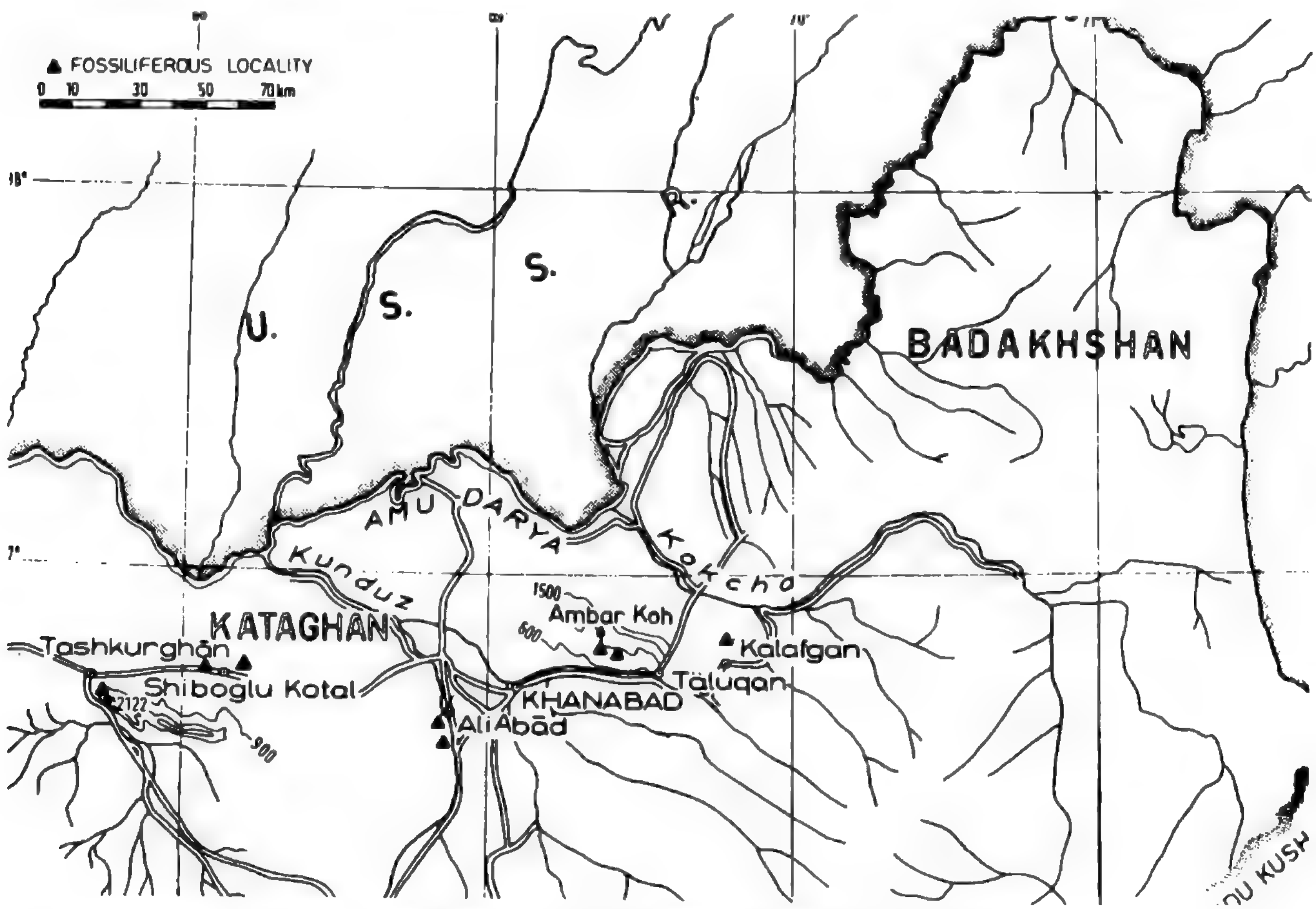


Fig. 1 - Sketch-map of the Paleogene fossiliferous localities.

TASHKURGAN (61 AD-59) — In the mountains south of Tashkurgan various levels in the Ambar Koh Formation have yelded fossils; the most fossiliferous horizon is level 3.

Level 1:

Ostrea (*Turkostrea*) *afghanica* Vialov
Ostrea (*Turkostrea*) *cizancourti* Cox

Level 3:

Fatina (*Fatina*) *beldersaiensis beldersaiensis* (Gorizdro, partim Vialov)
Fatina (*Fatina*) *beldersaiensis romanowskii* (Böhm)
Fatina (*Fatina*) *boehmi boehmi* (Vialov)
Fatina (*Fatina*) *boehmi transita* (Vialov)
Fatina (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov)
Fatina (*Sokolowia*) *esterhazyi buhsei* (Grewingk)
Venus everesti d'Archiac

Level 5:

Ostrea (*Cymbulostrea*) *multicostata* Deshayes
Ostrea (*Turkostrea*) *khaudaguensis* Vialov
Ostrea (*Turkostrea*) *turkestanensis borgalensis* Vialov

Level 8:

Ostrea (*Solidostrea*) *hemiglobosa* Romanovskiy
Gryphaea (*Gryphaea*) *latipyga* Vialov
Gryphaea (*Phygraea*) *tournali* (Doncieux)

The fauna of Tashkurgan consists completely of forms of rather limited distribution, with the exception of *Venus everesti*, which is somewhat longer-lived (extending through the whole Eocene), and of *Gryphaea* (*Phygraea*) *tournali* which is distributed in the Lower and Middle Eocene. All of the other species have been so far recorded only in one of the Eocene stages. In particular, the forms found in level 1 are found only in the Alai Stage, those of level 3 in the Turkestan stage, those of level 5 once more only in the Alai stage, and those of level 8 are present in the Suzak stage.

From the foregoing the Tashkurgan section can be assigned to an age between the Suzak and Turkestan stages.

Shiboglu Kotal (61 AD-58) — West of Shiboglu Kotal there occur the most fossiliferous of the localities studied; in the Ambar Koh Formation are numerous internal and external casts of Pelecypods. The species determined are:

Ostrea (*Cymbulostrea*) *multicostata* Deshayes
Ostrea (*Flemingostrea*) *schurabica* Vialov
Ostrea (*Turkostrea*) *afghanica* Vialov
Ostrea (*Turkostrea*) *cizancourti* Cox
Ostrea (*Turkostrea*) *khaudaguensis* Vialov
Ostrea (*Turkostrea*) *turkestanensis baissunensis* Böhm

Fatina (*Sokolowia*) *esterhazyi buhsei* (Grewingk)
Cavilucina (*Pegophysema*) *thebaica* (Zittel)
Pterolucina cf. *menardi* (Deshayes)
Diplodonta cycloidea (Bellardi)
Corbicula veneriformis (Deshayes)
Meretrix aegyptiaca (Mayer-Eymar)
Meretrix incrassata (Sowerby)
Meretrix transversa (Sowerby)
Venus everesti d'Archiac
Venus cf. *gumberensis* d'Archiac
Venus sp. ind. aff. *matheroni* Coquand

Several of the forms have a broad stratigraphical distribution; others are limited to a single bed; thus *Diplodonta cycloidea*, *Venus gumberensis*, *Meretrix incrassata*, *Meretrix transversa*, are distributed through the Eocene; *Venus matheroni*, *Meretrix aegyptiaca*, *Cavilucina* (*Pegophysema*) *thebaica*, are widespread in the Lower and Middle Eocene; *Corbicula veneriformis* is recorded only in the Thanetian; *Ostrea* (*Cymbulostrea*) *multicostata*, *Ostrea* (*Turkostrea*) *afghanica*, *O.* (*Turkostrea*) *cizancourti*, *O.* (*Turkostrea*) *khaudaguensis*, *O.* (*Turkostrea*) *turkestanensis baissunensis*, *Pterolucina menardi* are found only in the Alai stage; *Ostrea* (*Flemingostrea*) *schurabica*, *Fatina* (*Sokolowia*) *esterhazyi buhsei* in the Turkestan stage.

The age of the outcrop is therefore undoubtedly Eocene and it is assigned to between the Bukhara and Turkestan stages.

East of Shiboglu Kotal (61 AD-57) — On the east slope of Shiboglu Kotal, outside the zone detected, in the Ambar Koh Formation, only three forms were identified, two of which were from the genus *Amphidonte* and were represented by numerous specimens. The species determined are:

Gryphaea (*Ferganea*) *sewerzowi* Romanovskiy
Amphidonte galeata galeata (Romanovskiy)
Amphidonte galeata rotula (Vialov)

The forms are of restricted stratigraphical distribution, limited to a single stage or to a part of a stage. *Gryphaea sewerzowi* is in fact recorded in the lower part of the Sumssar stage (Middle Oligocene) at Ferghana and in the Tajik Depression; *Amphidonte galeata* and *Amphidonte galeata rotula* were found only in the Sumssar stage and only then at Ferghana.

The forms differentiated therefore indicate clearly that the age is Middle Oligocene.

Ali Abad (61 AE-90, AE-91/2, AE-92, AE-10/1) — The code 61 AE-91/2 denotes the specimens originating from the locality 4 km from Ali Abad, in the small valley which descends from the north-western slope of Koh-i-Yaka Badam, while 61 AE-10/1 and 61 AE-92 denote other finding at 8 km to the south of Ali Abad. Finally, with 61 AE-90 are denoted several samples which were not found in situ.

4 km south of Ali Abad in the sample 61 AE-91/2 taken from the Ambar Koh Formation was identified *Cardium kanleanum* Cotter, recorded in the Upper Eocene, *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, recorded in the Middle Eocene.

At 8 km south of Ali Abad, invariably in the Ambar Koh Formation, the following were recognised in the sample 61 AE-92:

Ostrea (*Cymbulostrea*) *multicostata* Deshayes
Ostrea (*Turkostrea*) *cizancourti* Cox
Ostrea (*Turkostrea*) *turkestanensis baissunensis* Böhm
Diplodonta cycloidea (Bellardi)
Cardium halaense d'Archiac
Cardium kanleanum Cotter
Arctica subathooensis (d'Archiac)
Arctica transversa (d'Archiac)
Meretrix semisulcata (Lamarck)

In the sample 61 AE-10/1 of the same locality was identified only:

Ostrea (*Turkostrea*) *cizancourti* Cox

Forms of rather restricted stratigraphical distribution are involved. With the exception of *Cardium halaense* and of *Diplodonta cycloidea*, which are widespread in the whole Eocene, all of the other species are mostly limited in distribution to the following stages: *Arctica subathooensis* and *A. transversa* to the Lower and Upper Eocene, *Meretrix semisulcata* to the Middle Eocene along with *Ostrea* (*Cymbulostrea*) *multicostata*, *O.* (*Turkostrea*) *cizancourti*, *O.* (*Turkostrea*) *turkestanensis baissunensis* recorded in the Alai stage, *Cardium kanleanum* in the Upper Eocene.

From the sample 61 AE-90, not in situ, the following were noted: *Ostrea* (*Turkostrea*) *afghanica* Vialov and *Ostrea* (*Turkostrea*) *cizancourti* Cox recorded in the Alai stage, *Liostrea* (*Kokanostrea*) *kokanensis* (Sokolow) recorded in the Turkestan stage and *Cardium halaense* d'Archiac, recorded in the whole Eocene.

It is seen that both the specimens collected in situ and those not in situ are referable to the Eocene sensu lato, on account of the presence of species distributed in the various stages of the Eocene from the Suzak stage to the Turkestan stage.

Ambar Koh (61 AE-89) — The macrofossils of Ambar Koh originate partly from the section investigated by Desio, Martina and Pasquaré (1961) and partly from specimens not collected in situ. The most fossiliferous horizons of the succession are 3 and 4.

Level 3 has yielded:

Pterolucina mokattamensis (Oppenheim)
Pterolucina pharaonis pharaonis (Bellardi)
Pterolucina pharaonis bialata (Bellardi)
Cardium kanleanum Cotter
Arctica transversa (d'Archiac)
Meretrix semisulcata (Lamarck)

Level 4 has yielded:

Fatina (Fatina) beldersaiensis romanowskii (Böhm)
Pterolucina pharaonis bialata (Bellardi)

Of the forms identified some have a broad stratigraphical distribution; others are restricted to a single stage. *Arctica transversa* has been recorded in the Lower and Upper Eocene; *Meretrix semisulcata* in the Middle Eocene; *Pterolucina pharaonis pharaonis* in the whole of the Eocene, *Pterolucina pharaonis bialata* in the Middle and Upper Eocene; *Cardium kanleanum* in the Upper Eocene; *Fatina (Fatina) beldersaiensis romanowskii* in the Upper Eocene (Turkestan stage).

The Ambar Koh section thus appears to be composed entirely of Eocene components from the Suzak to the Turkestan.

The species identified in the samples not in situ, corresponding to the code 61 AE-89/7, are:

Ostrea (Cymbulostrea) multicostata Deshayes
Ostrea (Turkostrea) cizancourti Cox
Ostrea (Turkostrea) khaudaguensis Vialov
Ostrea (Turkostrea) turkestanensis turkestanensis Romanovskiy
Ostrea (Turkostrea) turkestanensis alaica Vialov
Ostrea (Turkostrea) turkestanensis borgalensis Vialov
Ostrea sp. Vialov

Liostrea (Kokanostrea) kokanensis (Sokolow)
Gryphaea (Ferganea) sewerzowi Romanovskiy
Gryphaea (Gryphaea) smirnowi Romanovskiy
Fatina (Fatina) beldersaiensis beldersaiensis (Gorizdro, partim Vialov)
Fatina (Fatina) beldersaiensis romanowskii (Böhm)
Fatina (Fatina) boehmi boehmi (Vialov)
Fatina (Sokolowia) esterhazyi buhsei (Grewingk)
Fatina (Sokolowia) esterhazyi esterhazyi (Pavay, partim Vialov)

The forms involved are of very limited stratigraphical distribution, mostly limited to a single stage, viz: *Gryphaea (Gryphaea) smirnowi* to the Susak stage; *Ostrea (Cymbulostrea) multicostata, O. (Turkostrea) cizancourti, O. (Turkostrea) khaudaguensis, O. (Turkostrea) turkestanensis, O. (Turkostrea) turkestanensis alaica, O. (Turkostrea) turkestanensis borgalensis, Ostrea* sp. to the Alai stage; *Liostrea (Kokanostrea) kokanensis, Fatina (Fatina) beldersaiensis beldersaiensis, F. (Fatina) beldersaiensis romanowskii, F. (Fatina) boehmi boehmi, F. (Sokolowia) esterhazyi esterhazyi, F. (Sokolowia) esterhazyi buhsei* to the Turkestan stage; *Gryphaea (Ferganea) sewerzowi* is so far recorded only in the Sumssar stage (Middle Oligocene).

It is evident from the above that the fossils not in situ originated from different horizons of the Ambar Koh Formation, in that the various species identified are characteristic of various levels of the Eocene. The formation may thus be dated without any doubt to the Eocene. The finding of *Gryphaea (Ferganea) sewerzowi* Romanovskiy, so far recorded only in the Oligocene, is particularly interesting; it appears that the same conditions of sedimentation probably persisted into this epoch, although further evidence would be needed to corroborate this view.

Unnamed valley, North of Hugi Jangal (61 AD-55; 61 AD-55/1; 61 AD-55/2) — The samples coded 61 AD-55, 61 AD-55/1, 61 AD-55/2 have been considered along with those considered above 61 AE-89/7, since they also originate from the same zone. The specimens involved were collected on different occasions. The forms of Pelecypods identified in the different levels are:

61 AD-55

Fatina (Fatina) beldersaiensis beldersaiensis (Gorizdro, partim Vialov)
Fatina (Fatina) beldersaiensis romanowskii (Böhm)
Fatina (Fatina) boehmi boehmi (Vialov)
Fatina (Sokolowia) esterhazyi esterhazyi (Pavay, partim Vialov)
Fatina (Sokolowia) esterhazyi buhsei (Grewingk)

61 AD-55/1

Ostrea (*Turkostrea*) *khaudaguensis* Vialov
Ostrea (*Turkostrea*) *turkestanensis baissunensis* Böhm

61 AD-55/2

Ostrea (*Turkostrea*) *cizancourti* Cox
Ostrea (*Turkostrea*) *khaudaguensis* Vialov

Whereas all the species of *Fatina* identified are recorded from the Turkestan stage, the three species of *Ostrea* are recorded only in the Alai stage, consequent upon the critical investigation carried out on p. 170 for the sample 61 AE-89/7.

Kalafgan (fossiliferous locality N. 10 of geological map) (61 AE-65, 61 AE-66) — On the mountain 7 km north of Kalafgan, at an altitude of 1700 m, in the samples indicated with the code 61 AE-65, in grey limestone and marl of the Bluti Formation, the following forms have been found:

Ostrea (*Turkostrea*) *afghanica* Vialov
Fatina (*Fatina*) *boehmi boehmi* (Vialov)
Fatina (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov)

At about 1 km west-south-west of this outcrop, at about 1700 metres altitude, in the samples indicated with the code 61 AE-66, in the Bluti Formation, were recognised the following:

Ostrea (*Turkostrea*) *afghanica* Vialov
Ostrea (*Turkostrea*) *cizancourti* Cox
Fatina (*Sokolowia*) *esterhazyi buhsei* (Grewingk)

These species have a different stratigraphical distribution, being restricted to one or another of the Eocene stages. *Fatina* (*Fatina*) *boehmi boehmi*, *Fatina* (*Sokolowia*) *esterhazyi buhsei*, *Fatina* (*Sokolowia*) *esterhazyi esterhazyi* are distributed only in the Turkestan stage, while *Ostrea* (*Turkostrea*) *afghanica* and *Ostrea* (*Turkostrea*) *cizancourti* are recorded only in the Alai stage. An Eocene age is assignable to the outcrops adjacent to Kalafgan; they lie between the Alai stage (Middle Eocene) and the Turkestan stage (Upper Eocene).

Composition of the fauna

The paleontological material studied comprises a total of 400 specimens; they are mostly isolated and well preserved, and of both small and large dimensions. All are Pelecypods, among which have been recognised 42 forms. In the following list the general arrangement proposed by Vokes (1967) in « Genera of the Bivalvia » has been used, as regards the subgeneric and specific categories the detailed studies of various authors have been consulted. In particular, Vialov (1937, 1938, 1948) has been referred to for the Ostreids, and Chavan (1937-38, 1942) for the Lucinids. The species identified are:

Amphidonte galeata galeata (Romanovskiy)
Amphidonte galeata rotula (Vialov)
Fatina (Fatina) beldersaiensis beldersaiensis (Gorizdro, partim Vialov)
Fatina (Fatina) beldersaiensis romanowskii (Böhm)
Fatina (Fatina) boehmi boehmi (Vialov)
Fatina (Fatina) boehmi transita (Vialov)
Fatina (Sokolowia) esterhazyi esterhazyi (Pavay, partim Vialov)
Fatina (Sokolowia) esterhazyi buhsei (Grewingk)
Gryphaea (Ferganea) sewerzowi Romanovskiy
Gryphaea (Gryphaea) latipyga Vialov
Gryphaea (Gryphaea) smirnowi Romanovskiy
Gryphaea (Phygraea) tournali (Doncieux)
Liostrea (Kokanostrea) kokanensis (Sokolow)
Ostrea (Cymbulostrea) multicostata Deshayes
Ostrea (Flemingostrea) schurabica Vialov
Ostrea (Solidostrea) hemiglobosa Romanovskiy
Ostrea (Turkostrea) afghanica Vialov
Ostrea (Turkostrea) cizancourti Cox
Ostrea (Turkostrea) khaudaguensis Vialov
Ostrea (Turkostrea) turkestanensis turkestanensis Romanovskiy
Ostrea (Turkostrea) turkestanensis alaica Vialov
Ostrea (Turkostrea) turkestanensis baissunensis Böhm
Ostrea (Turkostrea) turkestanensis borgalensis Vialov
Ostrea sp. ind. Vialov
Cavilucina (Pegophysema) thebaica (Zittel)
Pterolucina menardi (Deshayes)
Pterolucina mokattamensis (Oppenheim)
Pterolucina pharaonis pharaonis (Bellardi)
Pterolucina pharaonis bialata (Bellardi)
Diplodonta cycloidea (Bellardi)

Cardium halaense d'Archiac
Cardium kanleanum Cotter
Arctica subhatooensis (d'Archiac)
Arctica transversa (d'Archiac)
Corbicula veneriformis (Deshayes)
Venus everesti d'Archiac
Venus cf. *gumberensis* d'Archiac
Venus sp. ind. aff. *matheroni* Coquand
Meretrix aegyptiaca (Mayer-Eymar)
Meretrix incrassata (Sowerby)
Meretrix semisulcata (Lamarck)
Meretrix transversa (Sowerby)

The 42 forms determined have been regrouped into 13 genera and 7 families partitioned between the orders *Pterioida* and *Veneroida*. The family represented by the most genera is undoubtedly the *Ostreidae* with 5 genera and 10 subgenera, which is followed by the families *Veneridae* and *Lucinidae* with 2 genera each. The other families are each represented by one genus. The most frequent genus as regard number of species is the genus *Ostrea* with 7 species, followed by the genera *Gryphaea* and *Meretrix* with 4, *Fatina*, *Pterolucina* and *Venus* with 3 and *Cardium* and *Arctica* with 2; the other genera are each present with a single species. As regard the abundance of individuals of a particular species, the list is headed by *Ostrea khaudaguensis* Vialov, with about 70 specimens, *Amphidonte galeata galeata* (Romanovskiy) with more than 38 specimens of right and left valves, followed by *Ostrea multicostata* Deshayes, *O. turkestanensis turkestanensis* Romanovskiy, *O. afghanica* Vialov, *O. cizancourti* Cox, *Fatina esterhazyi buhsei* (Grewingk), each presents with 20-30 specimens; *Ostrea turkestanensis baissunensis* Böhm, *Fatina esterhazyi esterhazyi* (Pavay, partim Vialov), with 10-20 specimens.

In all, the faunal assemblage is characterised by a marked predominance of Ostreids, both as regards number of species (50%) and individual (93%); among the latter, representatives of the genus *Ostrea* are the most abundant and widespread, despite the presence also of large numbers of *Gryphaea*, *Fatina* and *Amphidonte*.

Comparison with coeval fauna

A comparison with the coeval fauna of the same localities previously recorded by other students in Afghanistan is very significant in that the forms identified by them are very limited. Cox (1938) and Hinze (1964) have noted in Northern Afghanistan only 11 Eocene forms, of which the 9 following (comprising 81%) all belong to the family *Ostreidae*, in common with the forms studied by the present author: *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy (= *O. gigantica* Solander*), *O.* (*Turkostrea*) *afghanica* Vialov (= *O. multicostata strictiplicata* Raulin & Delbos), *O.* (*Turkostrea*) *cizancourti* Cox (= *Gryphaea cizancourti*), *O.* (*Turkostrea*) *turkestanensis* Romanovskiy (= *O. multicostata strictiplicata* Raulin & Delbos), *O.* (*Turkostrea*) *turkestanensis baissunensis* Böhm (= *O. multicostata strictiplicata* Raulin & Delbos), *Liostrea* (*Kokanostrea*) *kokanensis* (Sokolow) (= *Liogryphaea cocanensis* (Sokolow)), *Fatina* (*Fatina*) *beldersaiensis romanowskii* (Böhm) (= *O. esterhazyi romanovskii* Böhm), *F.* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov) (= *Gryphaea esterhazyi* Pavay).

Vialov, Nedelku and Niza (1966) have also recorded from Northern Afghanistan 18 forms of Eocene Pelecypods of which five (29%) are present also in the fauna studied by the present author. They are: *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy, *O.* (*Turkostrea*) *afghanica* Vialov, *O.* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy, *O.* (*Turkostrea*) *turkestanensis baissunensis* Böhm.

Extending the comparison to other faunas of region more or less near to that under consideration, it is seen that the greatest affinities are with the fauna of the Tajik Depression, followed by that of the Ferghana basin.

In the Tajik basin, Vialov (1948) has described 32 Eocene forms of which 17 are present in the Afghan fauna too, i.e. in 53% of the fauna of the Tajik Depression, composed of the following: *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, *O.* (*Flemingostrea*) *schurabica* Vialov, *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy, *O.* (*Turkostrea*) *afghanica* Vialov, *O.* (*Turkostrea*) *cizancourti* Cox, *O.* (*Turkostrea*) *khaudaguensis* Vialov, *O.* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy, *O.* (*Turkostrea*) *turkestanensis alaica* Vialov, *O.* (*Turkostrea*) *turkestanensis baissunensis* Böhm, *O.* (*Turkostrea*) *turkestanensis borgalensis* Vialov, *Ostrea* sp. ind. Vialov, *Liostrea* (*Kokanostrea*) *kokanensis* (Sokolow), *Gryphaea* (*Gryphaea*) *latipyga* Vialov, *Gryphaea* (*Gryphaea*) *smirnowi* Romanovskiy, *G.* (*Phygraea*) *tournali* (Doncieux), *Fatina* (*Fatina*) *boehmi boehmi* (*Vialov*), *F.* (*Sokolowia*) *esterhazyi csterhazyi* (Pavay, partim Vialov).

Vialov (1948) quotes from the Oligocene stages of the Tajik Depression five forms, only one of which is common to the present author's fauna: *Gryphaea* (*Ferganea*) *sewerzowi* Romanovskiy.

As regards the Ferghana basin, studied by Sokolow (1910), Vialov (1937b), Gekker, Osipova, Bel'skaya (1962), the following 13 forms out of a total of around 100 (13%) are common to ours: *Ostrea* (*Flemingostrea*) *schurabica* Via-

* Original identification in brackets.

lov, *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy, *O.* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy, *O.* (*Turkostrea*) *turkestanensis alaica* Vialov (= *O. turkestanensis* Romanovskiy), *O.* (*Turkostrea*) *turkestanensis borgalensis* Vialov (= *O. strictiplicata borgalensis* Vialov), *Liostrea* (*Kokanostrea*) *kokanensis* (Sokolow) (= *Ostrea kokanensis* Sokolow), *Fatina* (*Fatina*) *beldersaiensis beldersaiensis* (Gorizdro) (= *Gryphaea beldersaiensis* Gorizdro), *F.* (*Fatina*) *beldersaiensis romanowskii* (Böhm), *F.* (*Fatina*) *boehmi boehmi* (Vialov) (= *Gryphaea böhmi* Vialov), *F.* (*Fatina*) *boehmi transita* (Vialov) (= *Gryphaea böhmi transita* Vialov), *F.* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov) (= *Gryphaea esterhazyi* Pavay), *F.* (*Sokolowia*) *esterhazyi buhsei* (Grewingk) (= *Gryphaea esterhazyi buhsei* Grewingk), *Meretrix incrassata* (Sowerby).

The Oligocene fauna of the same basin is less rich in species, but nevertheless all three of the forms found are also present in Ferghana, i.e.: *Amphidonte galeata* (Romanovskiy) (= *Exogyra galeata* Romanovskiy and *Amphidonte ferganensis* Romanovskiy), *Amphidonte galeata rotula* (Vialov) (= *Amphidonte ferganensis* Romanovskiy), *Gryphaea sewerzowi* Romanovskiy.

If the comparison is extended to the faunas of more distant Asiatic basins, the affinities are somewhat less. Thus that of India, although very prolific in species, which were studied by d'Archiac and Haime (1854), has only seven in common with the Afghan fauna, i.e.: *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, *Pterolucina pharaonis pharaonis* (Bellardi), (= *Lucina pharaonis* Bellardi), *Cardium halaense* d'Archiac, *Arctica subhatooensis* (d'Archiac), *A. transversa* (d'Archiac), *Venus everesti* d'Archiac, *V. gumberensis* d'Archiac.

Of the faunas from outside Asia those of the Libyan and Senegalese basins are noteworthy. The first fauna comprises more than 100 species identified by Desio (1934) and Rossi (1942) and has in common only seven species: *Cavilucina* (*Pegophysema*) *thebaica* (Zittel) (= *Lucina thebaica* Zittel), *Pterolucina* cf. *menardi* (Deshayes) (= *Phacoides menardi* Deshayes), *Pterolucina mokattamensis* (Oppenheim) (= *Lucina mokattamensis* Oppenheim), *P. pharaonis pharaonis* (Bellardi) (= *L. pharaonis* Bellardi), *P. pharaonis bialata* (Bellardi) (= *Lucina pharaonis bialata* Bellardi), *Meretrix incrassata* (Sowerby), *Diplodonta cycloidea* (Bellardi).

The second (Senegalese) fauna, analysed by Tessier (1952) and Freneix and Gorodiski (1963), consists of about 200 species of Pelecypods, but has in common with the afghan fauna only the following eight: *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, *Cavilucina* (*Pegophysema*) *thebaica* (Zittel), *Pterolucina pharaonis pharaonis* (Bellardi) (= *Cavilucina pharaonis* (Bellardi)), *Cardium halaense* d'Archiac, *Arctica subhatooensis* (d'Archiac), *A. transversa* (d'Archiac), *Meretrix aegyptiaca* (Mayer-Eymar), *M. transversa* (Sowerby).

The perusal of the literature has led to the conclusion that the Eocene species which is most widely distributed geographically is *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, while the species most widespread in Central Asia are various *Ostreidae*, i.e. *Ostrea* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy, *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy, *Liostrea* (*Kokanostrea*) *kokanensis* (Sokolow), *Fatina* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov).

Among the species of other taxonomic groups the most widespread are *Meretrix incrassata* (Sowerby), *Pterolucina pharaonis pharaonis* (Bellardi), *Cavilucina* (*Pegophysema*) *thebaica* (Zittel), *Arctica transversa* (d'Archiac).

As regards the Oligocene, the most widespread species is undoubtedly *Amphidonte galeata* (Romanovski).

Conclusions

It may be concluded that most of the forms determined (33 out of 42) have not been previously recorded in Afghanistan. These 33 forms are: *Ostrea* (*Flemingostrea*) *schurabica* Vialov, *O.* (*Turkostrea*) *khaudaguensis* Vialov, *O.* (*Turkostrea*) *turkestanensis alaica* Vialov, *O.* (*Turkostrea*) *turkestanensis borgalensis* Vialov, *Ostrea* sp. ind. Vialov, *Gryphaea* (*Ferganea*) *sewerzowi* Romanovskiy, *G.* (*Gryphaea*) *latipyga* Vialov, *G.* (*Gryphaea*) *smirnowi* Romanovskiy, *G.* (*Phygraea*) *tournali* (Doncieux), *Fatina* (*Fatina*) *beldersaiensis beldersaiensis* (Gorizdro, partim Vialov), *F.* (*Fatina*) *boehmi boehmi* (Vialov), *F.* (*Fatina*) *boehmi transita* (Vialov), *F.* (*Sokolowia*) *esterhazyi buhsei* (Grewingk), *Amphidonte galeata* (Romanovskiy), *A. galeata rotula* (Vialov), *Cavilucina* (*Pegophysema*) *thebaica* (Zittel), *Pterolucina menardi* (Deshayes), *P. mokattamensis* (Oppenheim), *P. pharaonis pharaonis* (Bellardi), *P. pharaonis bialata* (Bellardi), *Diplodonta cycloidea* (Bellardi), *Cardium halaense* d'Archiac, *C. kanleanum* Cotter, *Arctica subhatooensis* (d'Archiac), *A. transversa* (d'Archiac), *Corbicula veneriformis* (Deshayes), *Meretrix aegyptiaca* (Mayer-Eymar), *M. incrassata* (Sowerby), *M. semisulcata* (Lamarck), *M. transversa* (Sowerby), *Venus everesti* d'Archiac, *V.* sp. ind. aff. *matheroni* Coquand, *V.* cf. *gumberensis* d'Archiac.

The nine remaining forms are: *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes, *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy, *O.* (*Turkostrea*) *afghanica* Vialov, *O.* (*Turkostrea*) *cizancourti* Cox, *O.* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy, *O.* (*Turkostrea*) *turkestanensis baissunensis* Böhm, *Liostrea* (*Kokanostrea*) *kokanensis* (Sokolow), *Fatina* (*Fatina*) *beldersaiensis romanowskii* Böhm, *F.* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov). They had all been already recorded in Northern Afghanistan.

The comparison between the fauna studied and the coeval one of other localities nearby demonstrates that many of forms recognised in Northern Afghanistan are present and widespread in the Tajik Depression and to a lesser extent in the Ferghana region (Vialov, 1937, 1948; Gekker, Osipova and Bel'skaya, 1962). In these regions the various species have been collected in sequence in exposed stratigraphical section and it is consequently possible to reconstruct the biostratigraphical succession of the Eocene and the Oligocene in the region under consideration. The resulting fauna for the two series is as follows:

Bukhara stage:	*Corbicula veneriformis* (Deshayes)
Suzak stage:	*Gryphaea* (*Gryphaea*) *latipyga* Vialov
	Gryphaea (*Gryphaea*) *smirnowi* Romanovskiy
	Gryphaea (*Phygraea*) *tournali* (Doncieux)
	Ostrea (*Solidostrea*) *hemiglobosa* Romanovskiy
	Cavilucina (*Pegophysema*) *thebaica* (Zittel)
	Pterolucina mokattamensis (Oppenheim)
	Pterolucina pharaonis pharaonis (Bellardi)
	Diplodonta cycloidea (Bellardi)
	Cardium halaense d'Archiac
	Arctica subhatooensis (d'Archiac)
	Arctica transversa (d'Archiac)
	Venus everesti d'Archiac
	Venus cf. *gumberensis* d'Archiac
	Venus sp. ind. aff. *matheroni* Coquand
	Meretrix aegyptiaca (Mayer-Eymar)
	Meretrix incrassata (Sowerby)
	Meretrix transversa (Sowerby)
Alai stage:	*Ostrea* (*Cymbulostrea*) *multicostata* Deshayes
	Ostrea (*Turkostrea*) *afghanica* Vialov
	Ostrea (*Turkostrea*) *cizancourti* Cox
	Ostrea (*Turkostrea*) *khaudaguensis* Vialov
	Ostrea (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy
	Ostrea (*Turkostrea*) *turkestanensis alaica* Vialov
	Ostrea (*Turkostrea*) *turkestanensis baissunensis* Böhm
	Ostrea (*Turkostrea*) *turkestanensis borgalensis* Vialov
	Cavilucina (*Pegophysema*) *thebaica* (Zittel)
	Pterolucina cf. *menardi* (Deshayes)
	Pterolucina mokattamensis (Oppenheim)
	Pterolucina pharaonis pharaonis (Bellardi)
	Pterolucina pharaonis bialata (Bellardi)
	Diplodonta cycloidea (Bellardi)

Cardium halaense d'Archiac
Venus everesti d'Archiac
Venus cf. *gumberensis* d'Archiac
Venus sp. ind. aff. *matheroni* Coquand
Meretrix aegyptiaca (Mayer-Eymar)
Meretrix incrassata (Sowerby)
Meretrix semisulcata (Lamarck)
Meretrix transversa (Sowerby)

Turkestan stage: *Fatina* (*Fatina*) *beldersaiensis beldersaiensis* (Gorizdro, partim Vialov)
Fatina (*Fatina*) *beldersaiensis romanowskii* (Böhm)
Fatina (*Fatina*) *boehmi boehmi* (Vialov)
Fatina boehmi transita (Vialov)
Fatina (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov)
Fatina (*Sokolowia*) *esterhazyi buhsei* (Grewingk)
Liostrea (*Kokanostrea*) *kokanensis* (Sokolow)
Ostrea (*Flemingostrea*) *schurabica* Vialov
Pterolucina pharaonis pharaonis (Bellardi)
Pterolucina pharaonis bialata (Bellardi)
Diplodonta cycloidea (Bellardi)
Cardium halaense d'Archiac
Cardium kanleanum Cotter
Arctica subhatooensis (d'Archiac)
Arctica transversa (d'Archiac)
Venus everesti d'Archiac
Venus cf. *gumberensis* d'Archiac
Meretrix incrassata (Sowerby)
Meretrix transversa (Sowerby)

Rischtan, Isphara and Khanabad stages not have samples.

Sumssar stage: *Amphidonte galeata galeata* (Romanovskiy)
Amphidonte galeata rotula (Vialov)
Gryphaea (*Ferganea*) *sewerzowi* Romanovskiy

It is seen from this list that the fauna of Badakhshan does not exhibit forms typical of the Bukhara stage, the presence of which is nevertheless documented by Vialov, Nedelku and Niza (1966) in the Northern Afghanistan on the basis of typical macrofossils such as *Gryphaea antiqua* (Schwetz).

The presence of the Suzak, Alai and Turkestan stages in the localities under examination may be stated with certainty from the discovery of the following forms characteristic respectively of the three stages: *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy for the first, representatives of the subgenus *Turkostrea* for the second, and of the genus *Fatina* for the third. Macrofossils belonging to the Rischtan, Isphara and Khanabad stages have not been found. The Sumssar stage was not noted, but its existence is considered by the authors quoted above to be possible. It is present only to the cast of Shiboglu Kotal, documented by the presence of *Gryphaea* (*Ferganea*) *sewerzowi* Romanovskiy, *Amphidonte galeata galeata* (Romanovskiy), and *Amphidonte galeata rotula* (Vialov).

PALEONTOLOGICAL DESCRIPTIONS

MOLLUSCA

Class Bivalvia

Subclass Pteriomorphia

Order Pterioida

Suborder Ostreina

Superfamily Ostreacea Rafinesque, 1815

Family Ostreidae Rafinesque, 1815

Genus **Amphidonte** Fischer von Waldheim, 1829

Amphidonte galeata galeata (Romanovskiy, 1882)

Pl. 26, fig. 1-4

1882 *Exogyra galeata* Romanovskiy. *Ferghanian Stage*, p. 56, pl. V, fig. 3-5.
1910 *Exogyra galeata* Sokolow. *Etage Férghanien*, p. 76, text-fig. 2.
1930 *Exogyra galeata* Kieh Yang. *Ostrea Eocene*, p. 99.
1937 *Exogyra galeata* Vialov. *Ostreids Ferghana*, p. 38, pl. XXXI, pl. XXXII.
1960 *Amphidonta galeata* Ebersin. *Osnovy Paleontologii*, p. 230, pl. XVI, fig. 2.
1962 *Amphidonta ferganensis* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana*, p. 137, pl. XIV, fig. 1-5.

Numerous left valves; three large right valves, well preserved. Left valve inequilateral, massive, suboval to subtriangular in shape, more high than long, with L/H ratio between 66% and 79%; rather convex with maximum convexity in the medio-umbonal region, decreasing abruptly on the anterior and posterior sides. Anterior margin convex, very elongate, continuing regularly into the ventral margin; posterior margin hollowed out beneath the umbo, then gradually becoming convex, continuing regularly with the ventral margin. Surface initially regular, incurving and then strongly following the course of the umbo, exhibiting a weak sulcus immediately beneath the umbonal region.

Ornament consisting of concentric lamellae, rather regular and rather dense (five per centimetre), undulate, strongly incurved towards the umbo and lifting again towards the posterior extremity so as to appear as sharp laminae; they combine and cross the ligament area, where they are however not pronounced; convexity and weak sulci also appear.

Umbo initially massive, then rather slender and sharp in the apical region, very recurved backwards, overlying the ligament area without covering it.

Internal surface not visible in the specimens examined. Ligament area triangular, very long, folded backwards, limited laterally by the terminal part of the growth lamellae.

Right valve inequilateral, opercular, suboval to triangular in shape, flattened, more high than long, with L/H ratio between 74% and 88%. Anterior margin initially oblique, then convex, continuing regularly with the ventral margin to delineate a semicircumference; posterior margin slightly concave, almost rectilinear, long and oblique, joined in a broad arc to the curvilinear ventral margin. Umbo flat, recurved. Ornament of about 33 concentric lamellae, not very regular, rather well spaced in the ventral and umbonal regions, denser in the medio-dorsal region. Dentellated margins.

Internal surface weakly concave, regular and very smooth; muscle scar relatively large although not very deep, situated in the postero-ventral part of the valve at about half the height. Ligament area reduced and filiform.

Dimensions —	l.v.	l.v.	l.v.	r.v.	r.v.
Height mm	140 ;	112 ;	89.2 ;	104 ;	57.9
Length mm	93 (66%);	79 (70%);	70.8 (79%);	77 (74%);	51 (88%)

Remarks — The most recent author to be interested in the genus *Amphidonte* is Mirkamalov (1964, p. 149), who gives in a brief article on the systematics of this genus a new diagnosis of it, also discussing several points given by Fischer, author of the genus, and makes useful comparisons with the morphologically adjacente *Ceratostreon*, *Exogyra, Rhynchostreon*. This author, as many Russian other ones, continues to employ the denomination *Amphidonta*, introduced by Scudder in 1882, despite the fact that Stenzel (1947, p. 169) and Vokes (1967, p. 193) have noted that the name was an unnecessary correction of *Amphidonte* and should have been deleted.

Gekker, Osipova and Bel'skaya in 1962 dealt with *Amphidonte ferganensis* (Romanovskiy), regrouping in it (both in the description on p. 137 and in the illustration in plates XIV and XV) also individuals belonging to *A. galeata*

(Romanovskiy), and to *A. galeata rotula* (Vialov). According to these authors the three forms mentioned above are merely different individuals from a single very variable species in which the change of a single character or rather the differing developments of height and length during growth produced the alteration of all the others, creating the impression of appreciable differences between separate specimens. In the material under examination the last two forms cited are however present with individuals exhibiting very pronounced differences, as a result of which, and taking the notes of Vialov into account, the writer prefers to keep these forms separate both from one another and from *A. ferganensis* considering the oval specimens to belong to *A. galeata galeata* (Romanovskiy) and the more rounded ones to *A. galeata rotula* (Vialov). The specimens under examination which are not excessively elongated are very similar to those from Ferghana illustrated by Vialov (1937 b, plates XXXI, XXXII) and by Gekker, Osipova, Bel'skaya (1962, plate XIV); as in these the umbo is not projecting and touches the surface of the valve without recovering the ligament area, is incurved in a place and not rolled up in a spiral, all characters which distinguish the species under consideration from *A. ferganensis*. The forms which present the characters of this last species are all illustrated by Gekker, Osipova, Bel' skaya, in plate XV.

The internal surface is not visible in the specimens studied, yet it would appear from the descriptions and illustrations of the authors consulted to be deep, with a well defined muscle scar cavity situated in the postero-ventral region.

Occurrence — *A. galeata galeata* (Romanovskiy) has been recorded in the Sumssar stage of Ferghana.

Locality — E. of Shiboglu Kotal. 61 AD-57.

Amphidonte galeata rotula (Vialov, 1937)

Pl. 27, fig. 1, 2

1937 *Exogyra galeata* var. *rotula* Vialov. *Ostreids Ferghana*, p. 40, pl. XXXIII.
1962 *Amphidonta ferganensis* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana*, p. 137 (pars).

Five left valves, several right valves, two large bivalve specimen, quite well preserved. Shell inequivalve, massive, with left valve much more convex than right. Left valve inequilateral, regularly rounded in shape, rather convex, with maximum convexity in the medio-umbonal region, rapidly decreasing towards the sides and more gently towards the ventral margin, slightly more high than long, with L/H ratio between 85% and 93%. Anterior margin very convex, long, gradually merging with the ventral margin; posterior margin initially straight, oblique, then convex and joined uniformly to the curvilinear ventral margin, delineating a semi-circumference. Surface asymmetrical, more expanded in the postero-ventral region, receding in the antero-ventral region; it has a strong curvature of the umbonal region towards the postero-dorsal margin. Ornament comprising concentric lamellae, irregularly spaced, with course parallel to the margins; at the posterior extremity they incurve towards the umbo, at the base of which they unite, rising to appear as sharp laminae; there also occur sulci, gibbosities and irregular folds which give the surface an undulate aspect.

Umbo massive, projecting slightly above the cardinal margin, strongly incurved towards the posterior margin, overlying the ligament area without covering it.

Ligament area long and narrow, incurved to follow the course of the umbo. Internal surface not visible.

Right valve opercular, inequilateral, with shape corresponding to that of the left valve; slightly more high than long, with L/H ratio between 92% and 96%, slightly convex in the medio-dorsal region, flattened in the umbonal and ventral regions. Anterior margin long, convex, joined to the ventral margin in an arc; posterior margin rectilinear, straight, rather short, becoming more convex by uniform passage into the curvilinear ventral margin. Surface asymmetrical with greatest development in the postero-ventral region. Ornament consisting of regular concentric lamellae, undulate, irregular folds and sulci, and dentellation on the margins. Umbo broad, flattened and folded towards the posterior margin.

Ligament area narrow, long, almost filiform, not standing above the umbo. Internal surface shallow, irregularly undulate, with hollowed-out semilunar muscle scar situated about in the centre of the valve.

Dimensions —

		l.v.	l.v.	r.v.	r.v.	b.
Height	mm	107.4;	88.9;	93.7;	74.7;	89
Length	mm	91.6 (85%);	82.8 (93%);	86.2 (92%);	72 (96%);	85 (95%)
Thickness	mm	42.4 (39%);	31.2 (35%);	—;	—;	52 (58%)

Remarks — *A. galeata rotula* (Vialov) differs from *A. galeata galeata* (Romanovskiy) in its regularly rounded shape; its umbo which projects less above the cardinal margin, is so strongly extended backwards that its extremity is beneath the level of the ventral margin of the cardinal area. The left valves are less easily distinguishable.

Occurrence — *A. galeata rotula* (Vialov) has been recorded in the Sumssar stage of the Ferghana gulf.

Locality — E. of Shiboglu Kotal. 61 AD-57.

Genus **Fatina** Vialov, 1936

Subgenus **Fatina** Vialov, 1936

Fatina (Fatina) beldersaiensis beldersaiensis (Gorizdro, 1913, partim Vialov, 1937)

Pl. 27, fig. 3-5

1913 *Gryphaea esterhazyi* var. *Belder-Saiensis* Gorizdro. *Mat. Turkestan*, p. 22, pl. 1, fig. 1, 2.
1937 *Gryphaea beldersaiensis* Vialov. *Ostreids Ferghana*, p. 22, pl. XVIII.
1938 *Fatina beldersaiensis* var. *beldersaiensis* Vialov. *Fatina and Turkostrea*, p. 16.
1948 *Fatina beldersaiensis* var. *beldersaiensis* Vialov. *Ostreids Tajik*, p. 69.

Seven left valves, medium to small, well preserved. Shell inequilateral and of subtriangular to oval shape, with average convexity particularly in the medio-umbonal region; more high than long, with L/H ratio between 71% and 74%. Anterior margins slightly convex or almost straight, passing in a broad arc into the ventral margin; posterior margin long and concave, forming an obtuse angle with curvilinear ventral margin. Surface almost symmetrical with a weak depression which separates the posterior region from the rest of the surface. Ornament of dichotomous radial costae, accentuated and well developed on the whole of the surface and of concentric lamellae. Umbo rather broad, strongly recurved on the ligament area, often with a slight twist towards the posterior region.

Ligament area slightly oblique, triangular, with a median depression limited by two narrow zones in relief, partly covered by the umbo. Internal surface hollowed out beneath the ligament area, with slight and uniform concavity in the whole of the remainder of the valve; muscle scar broad, semilunar, and subcentrally.

Dimensions — Height	mm	59 ;	55 ;	49
Length	mm	42.2 (72%);	41 (74%);	34.8 (71%)

Remarks — The only illustration of the species inspected has been that given by Vialov for specimens originating from Ferghana (1937 b, pl. XVIII); compared with the Afghan specimens they are larger, have a more symmetrical valve, a more massive umbonal region, and an umbo which is orthogyre and very incurved on to the ligament area. They agree however in dimensional ratios, in the absence of lateral wings, in the piriform internal surface, and in the well-developed radial costae on the whole of the surface. These are the features which distinguish this subspecies from other cogenetic forms; in particular, the radial costae permit the differentiation of the typical form from the subspecies *F. beldersaiensis romanowskii* (Böhm), which occurs in the material under examination.

Occurrence — *F.* (*Fatina*) *beldersaiensis beldersaiensis* (Gorizdro, partim Vialov) has been recorded in the Turkestan stage of the Ferghana basin.

Locality — Valley N. of Hugi Jangal (61 AD-55). Mountains S. of Tashkurgan (61 AD-59/3). Ambar Koh (61 AE-89/7).

Fatina (Fatina) beldersaiensis romanowskii (Böhm, 1903)

Pl. 28, fig. 2-5

1903 *Gryphaea Romanowskii* nov. nom. Böhm. *Eocäne Ferghana*, p. 103.

1910 *Gryphaea Romanowskii* Sokolow. *Étage Ferghanien*, p. 65, text-fig. 4, 5.

1938 *Ostrea esterhazyi* var. *Romanowskii* Cox. *Eocène Afghanistan*, p. 36, pl. IV, fig. 1.

1938 *Fatina beldersaiensis* var. *Romanowskyi* Vialov. *Fatina and Turkostrea*, p. 16.

1948 *Fatina beldersaiensis* var. *romanowskyi* Vialov. *Ostreids Tajik*, p. 69.

1962 *Fatina beldersaiensis* var. *romanowskyi* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana*, pl. IX, fig. 2 a-b.

Six left valves, small and medium sized, in a good state of preservation. Inequilateral valve, subtriangular to oval in shape, more high than long, with L/H ratio between 67% and 71%, averagely convex, with maximum convexity in the medio-umbonal region, decreasing more rapidly on the anterior margin than on the posterior one. Anterior margin convex, meeting the ventral margin in a broad arc; posterior margin initially rather concave, then convex and joining the curvilinear ventral margin in a broad arc. The asymmetrical surface has in the posterior region a rather narrow lobe, separated from the rest of the valve by a radial depression visible particularly towards the ventral margin. Ornament of radial dichotomous costae, accentuated in the umbonal region and hardly visible in the anterior region, disappearing at a variable distance from the umbo, and also comprising dense concentric lamellae visible particularly in the zone devoid of radial costae. Umbo massive, strongly recurved on the ligament area, often exhibiting an opisthogyre twist.

Ligament area oblique, triangular, with a median depression limited by two narrow zones in relief partly covered by the umbo. Internal surface hollowed out beneath the ligament area, with slight and uniform concavity in the whole of the rest of the valve; muscle scar not readly visible.

Dimensions —	Height	mm 73.8;	72;	67;	50
	Length	mm 52.6 (71%);	48 (67%);	46 (69%);	35 (70%)

Remarks — The specimens examined are enough similar to the illustration of the subspecies given by Gekker, Osipova, Bel'skaja (1962, pl. IX, fig. 2 a-b); as in this, there is present a more or less well-marked opisthogyre twist of the umbo, with greater development of the posterior region. They also have height exceeding length, undeveloped lateral wings, internal surface slightly and regularly hollowed-out, piriform, radial costae ill-defined and vanishing at a variable distance from the ventral margin and which are not present over the whole of the surface; the description of the species given by Vialov (1948, p. 56) also corresponds with respect to these characters.

In some specimens the costae are more prolonged, reaching as far as the ventral margin, but are not prominent and lacking in a few parts of the surface, resembling in this the figure of Gekker, Osipova, Bel'skaja.

F. (*Fatina*) *beldersaiensis romanowskii* (Böhm) is a transitional form to *F. nuda* Vialov, the final link in the series of *Fatina* studied. *Ostrea esterhazyi* var. *Romanowskii* (Böhm) studied by Cox (1938), is included in *Fatina beldersaiensis romanowskii* (Böhm), according to a critical review of previous Afghanistan studies by Vialov, Nedelku and Niza (1966, p. 153).

Occurrence — *F.* (*Fatina*) *beldersaiensis romanowskii* (Böhm) has been recorded in the Turkestan stage of the Ferghana basin and of the Afghanistan.

Locality — Valley N. of Hugi Jangal (61 AD-55). Mountains S. of Tashkurgan (61 AD-59/3). Ambar Koh (61 AE-89/4,/7).

Fatina (Fatina) boehmi boehmi (Vialov, 1937)

Pl. 28, fig. 1

1937 *Gryphaea Böhmi* Vialov. *Ostreids Ferghana*, p. 24, pl. XIV, fig. 1 a-b; pl. XV, fig. 1 a-b; pl. XVI, fig. 1.
1938 *Fatina Böhmi* var. *Böhmi* Vialov. *Fatina and Turkostrea*, p. 16.
1948 *Fatina* (*Fatina*) *böhmi* var. *böhmi* Vialov. *Ostreids Tajik*, p. 70, pl. XXXIII, fig. 1a-b.
1962 *Fatina böhmi* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana*, p. VII, fig. 2.

About ten left valves, large and well preserved. Shell subequilateral, massive and subtriangular, generally more high than long, with L/H ratio averaging 92%, moderately convex in the medio-umbonal region, declining with similar slopes on the anterior and posterior sides.

Anterior and posterior margins of appreciable thickness, slightly concave; at about half the valve height they meet the curvilinear ventral margin in a broad arc. Surface divided into three parts: a rather prominent central part and two laterals, anterior and posterior, fairly prominent but limited by a weak radial depression accentuated on the posterior side.

Ornament consisting of about 35 radial costae, rather dense, rounded, radiating from the region of the umbo as far as the ventral margin, interrupted at regular intervals by more marked concentric lamellae which become denser in the lateral region, rendering the ornament more irregular.

Umbo massive, slightly recurved on the ligament area. Internal surface rather fragmentary, on account of which the ligament area and the muscle scar are not clearly visible.

Dimensions — Height mm 80 ?; 80
Length mm 90 ; 74 (92%)

Remarks — The specimens examined show a certain variability; some are similar to the forms illustrated by Vialov (1937 b, pl. XIV, XV, XVI) and originating from Ferghana; two largely resemble those from the Tajik Depression (Vialov, 1948, pl. XXXIII). Compared with the first they have a broader umbonal region, a beak-shaped umbo, and lateral expansions which are continuous with the rest of the surface.

As regards agreement of specific characteristics, apparently only the height/length ratios do not correspond, but this may be due to incompleteness of the ventral regions of the specimens examined.

Occurrence — *F.* (*Fatina*) *boehmi boehmi* (Vialov) has been found in the Tajik Depression, where however it is scarse, in the Turkestan stage. In the same stage it has been found at Ferghana (the material from Ferghana was used for the treatise by Vialov) and in the Trans-Alai range.

Locality — Valley N. of Hugi Jangal (61 AD-55). Mountains S. of Tashkurgan (61 AD-59/3). Ambar Koh (61 AE-89/7). N. of Kalafgan (61 AE-65).

Fatina (Fatina) boehmi transita (Vialov, 1937)

Pl. 29, fig. 5

1937 *Gryphaea Böhmi* ssp. *transita* Vialov. *Ostreids Ferghana*, pl. XVII.

1938 *Fatina Böhmi* var. *transita* Vialov. *Fatina and Turkostrea*, p. 16.

1948 *Fatina böhmi* var. *transita* Vialov. *Ostreids Tajik*, p. 69.

1962 *Fatina böhmi* var. *transita* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana*, pp. 95, 121.

Two moderately preserved left valves and a fragment of a left valve, of large dimensions. Valve massive, subtriangular in shape, suboval, subequilateral, more high than long, with L/H ratio about 85%, convex particularly in the medio-umbonal region. Anterior and posterior margins of appreciable thickness, lamellose, long, almost straight or slightly concave, diverging from the umbo with slight inclination; beyond the mid-height of the valve they meet the ventral margin in a broad curvilinear arc. Surface almost symmetrical, with slightly developed lateral wings not separated from the rest of the valve.

Ornament of about 35 radial dichotomous costae, rounded, accentuated in the umbonal and medio-dorsal region, weak or lacking in the ventral region, and of concentric lamellae which give the costae a scaly aspect.

Umbo massive, slightly recurved on the ligament area. Ligament area rather extended, more broad than high, with h/l ratio between 56% and 75 %, and exhibiting a broad median depression limited by two lateral zones in relief but poorly developed. Internal surface concave, piriform, hollowed-out beneath the ligament area, with muscle scar hardly visible.

Dimensions —	Height	mm 87 ;	76
	Length	mm 74 (85%);	—

Remarks — The specimens examined exhibit characteristics totally in agreement with the descriptions of the subspecies-type given by Vialov (1948, p. 69): height exceeding length, lateral wings poorly developed and not separated from the rest of the shell, internal surface concave and not well defined. They have however larger dimensions and slightly different ornament. The radial costae are not developed over the entire surface, contrary to the statement of Vialov, but extend from the umbo to the medio-dorsal region. On the other hand however the radial costae also vanish towards the ventral margin in the form from Ferghana reproduced by Vialov (1937 b, pl. XVII), which is the only illustration examined by the present author.

According to the author, *F. boehmi transita* (Vialov) represents a transitional form between *F. boehmi boehmi* (Vialov) and *F. beldersaiensis beldersaiensis* (Gorizdro, partim Vialov).

Occurrence — *F.* (*Fatina*) *boehmi transita* (Vialov) has been recorded in the Turkestan stage of the Ferghana basin.

Locality — Mountains S. of Tashkurgan. 61 AD-59/3.

Subgenus **Sokolowia** Böhm, 1933

Fatina (Sokolowia) esterhazyi esterhazyi (Pavay, 1871, partim Vialov, 1937)

Pl. 29, fig. 1, 2; Pl. 30, fig. 1

1871 *Gryphaea esterhazyi* Pavay. *Kolozswar Környakének*, p. 379, pl. VI-IX.
1937 *Gryphaea esterhazyi* Vialov. *Ostreids Ferghana*, p. 20, pl. XI, fig. 1 a-b.
1938 *Fatina esterhazyi* var. *esterhazyi* Vialov. *Fatina and Turkostrea*, p. 16.
1948 *Fatina* (*Sokolowia*) *esterhazyi* var. *esterhazyi* Vialov. *Ostreids Tajik*, p. 73, pl. XXIX, fig. 1 a-b; pl. XXX, fig. 1 a-b; pl. XXXI, fig. 1-3; pl. XXXII, fig. 1-3 (*cum syn.*).
1962 *Fatina esterhazyi* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana*, vol. 2, pl. X, fig. 2; pl. XI, fig. 2; pl. XII, fig. 1.

Ten large and medium sized left valves, well preserved; four right valves. Left valve strongly convex, subequilateral, deltoidal in shape owing to the presence of two alar expansions in antero- and postero-ventral positions, as a result of which the valve length sometimes becomes equal to the height or even exceeds it, characterising the species. Anterior and posterior margins straight initially, then becoming concave as far as the alar projection; regularly convex, they then meet the curvilinear ventral margin in a broad arc. Surface sometimes divided longitudinally by two radial depressions into three parts: a more convex central part and two somewhat flattened lateral parts which form the alar projections. Normally developed specimens have an almost symmetrical form. Surface generally smooth; only about 25 small radial costae are visible, slender and close together, in the umbonal region and for a short distance; they quickly disappear and only the well defined concentric lamellae then remain.

Umbo rather narrow, very high, strongly recurved, with apex covering the ligament area. Ligament area rather oblique.

Internal surface smooth, regular, rather deep, with broad prominent semicircular muscle scar situated towards the ventral margin in the lower quarter of the valve.

Right valve inequilateral, subpentagonal in shape, winged by the presence of two lateral expansions, which start immediately beneath the umbonal region; the dorsal surface is concave. Anterior margin rather short, forming a near right-angle with the ventral margin. Posterior margin oblique, meeting the subrectilinear ventral margin in an obtuse angle.

Ornament comprising close fine concentric striations and irregular concentric folds.

Dimensions —

		l.v.	l.v.	r.v.
Height	mm	75 ;	47;	38.1 ?
Length	mm	68 (91%);	?;	40

Remarks — The specimens examined have the following features in common with those from Ferghana illustrated by Vialov (1937 b) and by Gekker, Osipova, Bel'skaja (1962): narrow umbo, folded laterally and distinct from the remainder of the valve; oblique ligament area. One specimen (61 AD-59/3) is more similar to the one from the Tajik Depression illustrated by Vialov (1948, pl. XXXI; pl. XXXII, fig. 1-3) in having a massive umbo which is not folded laterally, and a straight ligament area.

According to the author of the species (1948, p. 73), *F. esterhazyi esterhazyi* is a form more long than high; this characteristic does not seem to be present in the specimens studied, or even in some of the illustrations of Vialov, probably as a result of the difficulty in finding complete shells. The other characters, i.e.

well developed laterals wings, ovoidal internal cavity, radial costae on the apex, are clearly visible and permit the identification of the Afghan specimens with the species in question.

The limitation of the radial ornament to the umbonal region is precisely the feature which differentiates *F. esterhazyi esterhazyi* from *F. boehmi boehmi* with which it is associated in the Turkestan stage.

According to Vialov, *F. esterhazyi esterhazyi* represents the origin of a series of forms of the genus *Fatina*, which concludes with *F. nuda* Vialov after a gradual change in the specific characters listed above; this latter species is more high than long, with undeveloped lateral wings, a hollow and deltoid internal surface, and a smooth exterior, except in the apex of the valve. One of the Afghan specimens possesses these characters (pl. 30, fig. 2), but since the species does not appear to have been illustrated it cannot be classified with certainty, there being only the evidence of the description by Vialov (1948, p. 73).

Occurrence — *F.* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov) has been recorded in Central Asia only in the Turkestan stage. It has been found in Ferghana, at in the Alai and Trans-Alai ranges. Vialov has found some specimens of these Ostreas in the Paleogene of Turkmenistan. The species has also been recorded in Northern Iran and at Kasgar, and is very widespread also in the Upper Eocene of Transylvania.

Locality — Valley N. of Hugi Jangal (61 AD-55). Mountains S. of Tashkurgan (61 AD-59/3). Ambar Koh (61 AE-89/7). N. of Kalafgan (61 AE-65).

Fatina (Sokolowia) esterhazyi buhsei (Grewingk, 1853)

Pl. 29, fig. 3, 4

1937 *Gryphaea esterhazyi* var. *buhsei* Vialov. *Ostreids Ferghana,* p. 21 (pars), pl. XIII.
1938 *Fatina esterhazyi* var. *buhsei* Vialov. *Fatina and Turkostrea,* p. 16.
1948 *Fatina esterhazyi* var. *buhsei* Vialov. *Ostreids Tajik,* p. 69.
1962 *Fatina esterhazyi* var. *buhsei* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana,* pl. VIII, fig. 1 a-b; pl. IX, fig. 1 a-b; pl. X, fig. 1.

Twenty left valves, some right valves and a bivalve shell, rather well preserved. Shell inequivalve, massive, triangular, with two lateral expansions which protrude immediately beneath the umbonal region.

Left valve subequilateral, more high than long, rather convex with maximum convexity in the medio-dorsal region, decreasing with the usual slope on the anterior and posterior sides. The anterior and posterior margins diverge symmetrically from the apex, the posterior one being longer than the anterior; rather concave as far as the alar projections, they then become regularly convex, meeting the curvilinear ventral margin in a broad arc. The dorsal surface exhibits two lateral lobes, of which the anterior one is more visible, separated by broad shallow radial sulci. Ornament consisting of about twenty rounded radial costae, sometimes divided, rather ill-defined, separated by shallow sulci; they radiate from the umbonal region, where they are particularly dense and evident, and disappear, regularly spaced, towards the ventral margin; concentric lamellae give the valve a rugose appearance. Umbonal region strongly convex, umbo orthogyre or slightly opisthogyre, rather recurved on the ligament area.

Internal surface with regular concavity, not very deep, with large semicircular muscle scar situated towards the ventral margin of the valve. Ligament area subrectangular, with length exceeding breadth, with h/l ratio between 51 and 57%, exhibiting a median depression limited by two rather broad lateral zones in relief.

Right valve inequilateral, subpentagonal in shape, winged by the presence of two lateral expansions which protrude immediately beneath the umbonal region; dorsal surface weakly concave in the medio-umbonal region, where it has the lesser thickness. Anterior margin long, almost straight, forming an obtuse angle with the ventral margin; posterior margin slightly concave, but very long and joined with an obtuse angle to the curvilinear ventral margin.

Dimensions —

		l.v.	l.v.	r.v.
Height	mm	73.8 ;	55 ?;	39
Length	mm	59 (80%);	40 ;	37 (95%)

Remarks — The specimens examined tally with the illustrations of the species given by Gekker, Osipova, Bel'skaja (1962, pl. IX), particularly as regards dimensions; like these specimens and in contrast to those studied by Vialov, their height exceeds their length.

All of the other specific characters correspond with those given by Vialov (1948, p. 69). In the subspecies under examination the present writer has also included several specimens from the zone indicated (61 AD-58), which represent intermediate types between the typical form and the subspecies; they have well defined radial costae, but only in the umbonal region, and very developed concentric lamellae.

Occurrence — *F.* (*Sokolowia*) *esterhazyi buhsei* (Grewingk) has been recorded in the Ferghana region of the Turkestan stage.

Locality — Valley N. of Hugi Jangal (61 AD-55). W. slope of Shiboglu Kotal (61 AD-58). Mountains S. of Tashkurgan (61 AD-59/3). Ambar Koh (61 AE-89/7). N. of Kalafgan (61 AE-66).

Genus **Gryphaea** Lamarck, 1801

Subgenus **Ferganea** Vialov, 1936

Gryphaea (Ferganea) sewerzowi Romanovskiy, 1883

Pl. 31, fig. 4, 5

1883 *Gryphaea sewerzowi* Romanovskiy. *Sap. Mineralog. Obsh.*, p. 251.
1937 *Gryphaea sewerzowi* Vialov. *Ostreids Ferghana*, p. 36, pl. XXVII, fig. 1, 2.
1948 *Gryphaea (Ferganea) sewerzowi* Vialov. *Ostreids Tajik*, p. 81, pl. XXXIV; pl. XXXV, fig. 2; pl. XXXVI; pl. XXXVII.

Six medium-sized left valves, rather well preserved. Valve massive, inequilateral, irregularly elongate in shape, oval, more narrow towards the umbo, more high than long, with L/H ratio between 56% and 77%; very convex, with maximum convexity in the medio-dorsal region, more rapidly decreasing on the posterior side than on the anterior one. Anterior margin rather short, slightly sinuous, projecting on the internal cavity and passing uniformly into the ventral one; posterior margin very long, slightly convex and joined to the curvilinear ventral margin in a narrow arc. Surface divided into two by a transversal shallow depression particularly visible under the umbonal region. Ornament comprising scaly growth lamellae, irregularly interrupted, and of convexity in the umbonal region.

Umbo beak-shaped, only slightly differentiated from the remainder of the dorsal surface, folded forwards.

Ligament area subtriangular in outline, very long, with h/l ratio between 57% and 76%; median depression limited by rather long raised margins. Internal surface deep, with anterior margin strongly projecting; muscle scar not very prominent, semilunar, situated towards the ventral margin.

Dimensions —	Height	mm	70 ;	58 ;	57
	Length	mm	43 (61%);	32.5 (56%);	44 (77%)

Remarks — The specimens examined are more similar to those of the Tajik Depression (Vialov, 1948) than to those of Ferghana (Vialov, 1937 b) which have larger dimensions, an umbo gryphoid and more differentiated from the rest of the surface, and an umbonal region folded laterally. Also one of the specimens examined has the umbonal region slightly incurved towards the sides, but has a short non-gryphoid umbo.

The thickness of the left valve, the exceptionally high ligament area with thicker borders and the forward curvature of the umbo (when it is present) allow this species to be readily distinguished from the other *Gryphaeae* of the Paleogene of Asia.

There are certain resemblances to the left valves of *Liostrea kokanensis* (Sokolow), which however is of much smaller size and has ornament consisting of thin growth lines and not of lamellose bands.

The right valve is not preserved in the specimens studied; according to the description of Vialov (1948) it is flattened, slightly concave, irregular in shape, piriform, with projecting anterior margin, and covered by scaly growth lamellae.

Occurrence — *G.* (*Ferganea*) *sewerzowi* Romanovskiy has been recorded in the lower part of the Sumssar stage of the Ferghana basin, and in the Tajik Depression.

Locality — E. of Shiboglu Kotal (61 AD-57). Ambar Koh (61 AE-89/7).

Subgenus **Gryphaea** Vialov, 1936

Gryphaea (Gryphaea) latipyga Vialov, 1948

Pl. 31, fig. 1, 2

1948 *Gryphaea* (*Gryphaea*) *latipyga* Vialov. *Ostreids Tajik*, p. 28, pl. XI, fig. 1 a-b.

Two specimens of the left valve, of large and medium dimensions, very well preserved. Valve inequilateral, of subtriangular shape, more high than long, with L/H ratio average 89%, very convex, with maximum convexity in the medio-dorsal region, decreasing abruptly on the anterior margin, and more gently on the posterior margin. Anterior margin sligthly convex passing uniformly into the ventral margin; posterior margin almost rectilinear, oblique and considerably extended, forming a broad arc with the curvilinear ventral margin. Surface asymmetrical, receding anteriorly, more expanded posteriorly. Umbo rather distinct, punctate, not folded back on the ligamental area.

Ornament comprising robust growth lamellae, undulating and scaly, rather close together on the whole surface except for the vicinity of the ventral margin, where they are irregular and more widely spaced, almost forming small steps. There is no trace of radial costae.

Internal surface poorly visible, but probably more hollowed-out anteriorly. Ligament area subtriangular or subquadrangular with h/l ratio different in the two specimens; 0,33 in one, and around unity in the other.

Dimensions —	Height	mm	89 ;	62
	Length	mm	79.8 (89%);	52 (84%)

Remarks — The two specimens examined are very similar to those described by Vialov (1948); one of the same size, the other smaller; they exhibit however a large convexity which appears suddenly in the preumbonal region, giving rise to a hump, and continuing in the medio-dorsal region, gradually diminishing towards the ventral margin.

Gryphaea latipyga Vialov is related via *Gryphaea smirnowi lata* with the typical *Gryphaea smirnowi*; it differs from this form in its lesser asymmetry, its greater convexity and in the rectilinearity of the anterior and posterior margins of the left valve. The greater convexity also readily distinguishes it from *Gryphaea tournali* (Doncieux).

Occurrence — *G.* (*Gryphaea*) *latipyga* Vialov has been recorded in the Suzak stage at Toutkaul (Tajik Depression).

Locality — Mountains S. of Tashkurgan. 61 AD-59/8.

Gryphaea (Gryphaea) smirnowi Romanovskiy, 1884

Pl. 30, fig. 3

1884 *Gryphaea smirnowi* Romanovskiy. ***Histor.*** *Geol.*, p. 46, pl. XI, fig. 1.
1948 *Gryphaea* (*Gryphaea*) *smirnowi* Vialov. *Ostreids Tajik*, p. 23, pl. VIII, fig. 1 a-b, 2.

Three left valves of medium and small dimensions, not very well preserved. Valve inequilateral, suboval, more high than long, moderately convex, rapidly decreasing with the same slope on the two sides, narrow at the umbo. Anterior margin incomplete in the specimens under examination; posterior margin strongly concave beneath the umbo, and joining the ventral margin in an obtuse angle. Surface divided transversally in two by a deep depression situated at about a third of the height, resulting in a constriction beneath which the surface broadens markedly to form a postero-ventral expansion characteristic of the species. Ornament comprising distinct concentric lamellae and rounded radial costae, the latter indistinct and not always visible.

Umbo massive, slightly recurved, presenting a slight torsion towards the anterior part.

Internal surface very deep, particularly beneath the ligament area, which is rather reduced and not visible, muscle scar accentuated and hollowed-out, semilunar and positioned towards the ventral margin at about 68% of the total height.

Dimensions —	Height	mm 50 ;	33
	Length	mm 32 ?;	?

Remarks — In the specimens examined the course of the anterior margin is not entirely visible; from the illustration of the species given by Vialov (1948, pl. VIII, fig. 1, 2) it appears convex and joined in a broad arc with the ventral margin; the umbo is slightly gryphoid and the characteristic postero-ventral expansion is very evident.

Vialov (1948, p. 25) provides useful comparative observations with various systematic units morphologically adjoining the species under examination: *G. errara* Vialov, *G. sicardi* Doncieux, *G. sewerzowi* Romanovskiy, *G. smirnowi lata* Vialov, *G. latipyga* Vialov. As some species are represented in the material being examined, the writer has been able to directly compare the morphological differences between the above-mentioned groups and to observe the end-points of the trend which connect *G. smirnowi* Romanovskiy with several species which at first glance appear to have but little in common with it. The main link is provided by the less convex subspecies *G. smirnowi lata*, which has preumbonal region and ligament area broader than in the type-species. This subspecies passes into *G. latipyga* Vialov, characterised by symmetrical left valves, yet broader and at the same time more swollen. The holotype discovered in the village of Toutkaul in the Tajik Depression was described by Romanovskiy as being from the Upper Cretaceous; on the contrary actually the concerned outcrop is of the Suzak stage. All of the material studied by Vialov is from the same locality and from the same strata.

Occurrence — *G.* (*Gryphaea*) *smirnowi* Romanovskiy has been recorded in the Suzak stage of the Tajik Depression.

Locality — Ambar Koh. 61 AE-89/7.

Subgenus **Phygraea** Vialov, 1936

Gryphaea (Phygraea) tournali (Doncieux, 1911)

Pl. 31, fig. 3

1911 *Ostrea tournali* Doncieux. *Nummulitique Aude et Hérault*, p. 23, pl. V, fig. 1, 2, 3.
1948 *Gryphaea* (*Phygraea*) *tournali* Vialov. *Ostreids Tajik*, p. 28, pl. XII, fig. 2, 3.
1954 *Ostrea* cf. *tournali* Salvan. *Invertébré marocains*, p. 52, text-fig. 20.

One medium-sized left valve, well preserved. Valve inequilateral, massive, suboval in shape with a tendency to subtriangularity, with expanded ventral region, more high than long with L/H ratio averaging 84%; averagely convex, maximum convexity in the medio-dorsal region, falling away sharply on the sides, but more slowly on the ventral margin. Anterior margin convex and elongate, passing uniformly into the ventral margin; posterior margin gently concave, almost straight, joining the curvilinear ventral margin in a broad arc. Surface asymmetrical owing to a postero-ventral expansion which is limited dorsally by a broad depression situated at about half the height, following the course of the growth lamellae and thus accentuating the characteristic curvature of the valve. Ornament consisting of concentric growth lamellae, slightly undulate, regularly spaced, incurving strongly posteriorly towards the umbo and then becoming straight so as to stand out like thin plates; they merge and also pass into the ligament area, where they are however hardly distinguishable. Gibbosity and weak sulci give the exterior surface an undulate appearance.

Umbo massive, folded towards the posterior margin, overlying the ligament area without covering it.

Internal surface not very deep, more hollowed-out beneath the ligament area and along the ventral margin; muscle scar large, semilunar, situated posteriorly, at about half the height of the valve. Ligamental area narrow, very elongated, strongly folded parallel to the umbonal curvature.

Dimensions —	Height	mm 65
	Length	mm 55 (84%)
	Thickness	mm 25 (38%)

Remarks — The only specimen examined exhibits some convexity on its dorsal surface, a postero-ventral expansion separated from the rest of the shell by a broad depression, an umbonal region rather narrow and separate, characters which are less accentuated or less visible in the illustrations of the species given by Vialov (1948). Salvan (1954) illustrates the internal surface of a cast which is much higher than that being examined, and having a narrower umbonal region, a truncated umbo, an uncovered and straight ligament area; the Afghan specimen possesses however a narrow ligament area which is folded following the twist of the umbo, as also occurs in the typical form of Doncieux (pl. V, 1911).

Occurrence — *G.* (*Phygraea*) *tournali* (Doncieux) is recorded in the Eocene of France, rarely in the Sparnacian, is abundant in the Ypresian, represented by gigantic forms in the Lutetian, and has been recorded in the Suzak stage of the Tajik Depression.

Locality — Mountains S. of Tashkurgan. 61 AD-59/8.

Genus **Liostrea** Douvillé, 1904

Subgenus **Kokanostrea** Vialov, 1936

Liostrea (Kokanostrea) kokanensis (Sokolow, 1910)

Pl. 31, fig. 6, 7

1910 *Ostrea kokanensis* Sokolow. *Etage Ferghanien*, p. 73, text-fig. 7 a-c.
1933 *Liogryphaea kokanensis* Böhm. *Palaeogene Ost-Turkestans*, p. 110, pl. X, fig. 2 a-b.
1937 *Ostrea kokanensis* Vialov. *Ostreids Ferghana*, p. 26, pl. XVI, fig. 2-4.
1948 *Liostrea (Kokanostrea) kokanensis* Vialov. *Ostreids Tajik*, p. 76, pl. XXXVIII, fig. 5-7.

Three left valves, moderately preserved, of small and medium size. Valve inequilateral with suboval shape, more high than long, with weak convexity slowly decreasing towards the anterior margin, but more rapidly towards the posterior one. Anterior margin rather long, weakly convex, passing gradually into the curvilinear ventral margin. Concave posterior margin, particularly immediately beneath the umbonal region, meeting the ventral margin in a broad arc. Valve surface asymmetrical on account of a narrow posterior lobe separated by a weak depression from the rest of the surface, and by the large extension of the anterior region. Ornament comprising only concentric striae, not lamellar, weak and hardly visible; radial costae completely absent, even in the apical region.

Umbo massive, slightly folded on the ligament area, with a twist towards the anterior part of the valve.

Internal surface smooth, hollowed out beneath the ligament area, shallow and uniform in all the rest of the valve. Ligament area oblique, subtriangular, more broad than high, with h/l ratio approx. 45%.

Dimensions — Height	mm	57 ;	40 ;	30
Length	mm	39 (68%);	31.6 (79%);	20 (67%)

Remarks — One of the specimens (sample 61 AE-89/7) has noteworthy dimensions, heavy and lamellar margins, high and slightly oblique ligament area; the others are by contrast small, flattened, with thin margins and oblique ligament area overlying the internal cavity; these latter largely resemble the representations of the species given by Vialov (1937, 1948) and by Sokolow (1910). They all have in common however the characteristic ornament consisting only of concentric lines, the torsion and the umbonal truncation.

The specimens figured by Vialov, originating from Ferghana and from the Tajik Depression, have a rather variable shape, as do those under examination; suboval to subtriangular and subquadrangular. The specimens reproduced by Sokolow (1910) are however small and of more regular and constant form. In 1933 Böhm produced a specimen which was high, narrow, smooth and with a straight umbo.

Forms morphologically most similar to the species under examination are the juvenile stages of *Gryphaea sewerzowi* Romanovskiy, of *Fatina* and of *Turkostrea*. The species under consideration differs from the first in having non-lamellar growth lines, by the absence of floting along the posterior margin, and by the ligament area overlying the internal cavity; it is distinguished from juvenile forms of *Fatina* and *Turkostrea* by the total absence of radial ornament.

Occurrence — *L.* (*Kokanostrea*) *kokanensis* (Sokolow) occurs somewhat rarely in the Turkestan stage of the Tajik Depression, more frequently in Ferghana;

Vialov also records it in the Trans-Alai range and Böhm in Ost-Turkestan.

Locality — Ali Abad (not in situ) (61 AE-90). Ambar Koh (61 AE-89/7).

Genus **Ostrea** Linnaeus, 1758

Subgenus **Cymbulostrea** Sacco, 1897

Ostrea (Cymbulostrea) multicostata Deshayes, 1824

Pl. 32, fig. 1-3

1824 *Ostrea multicostata* Deshayes. *Foss. envir. Paris,* vol. 1, p. 363, pl. LVII, fig. 3-6.
1861-1871 *Ostrea multicostata* ? Wood. *Eocene Bivalves England,* vol. 1, p. 28, pl. VI, fig. 3 a-b.
1893 *Ostrea multicostata* Thomas. *Tertiaire et Sécondaire Tunisie,* p. 7.
1903 *Ostrea multicostata* Oppenheim. *Alttertiärer Faunen Aegypten,* p. 29, pl. I, fig. 8-9.
1930 *Ostrea multicostata* Kieh Yang. *Ostrea Eocène,* p. 89(pars), pl. VI, fig. 1-4, 8-11; pl. VII, fig. 1.
1948 *Ostrea (Cymbulostrea) multicostata* Vialov. *Ostreids Tajik,* p. 64, pl. XXVI, fig. 1; pl. XXVII, fig. 1, 2; pl. XXVIII, fig. 2, 3.
1950 *Ostrea multicostata* Gorodiski. *Ostréidés Nummulitique Sénégal,* p. 355, pl. 18, fig. 2.
1951 *Ostrea multicostata* Eames. *Eocene Pakistan and India,* p. 356.
1954 *Ostrea multicostata (tipica)* Salvan. *Invert. marocains,* p. 38, pl. III, fig. 1-2, 10-11.
1962 *Ostrea multicostata* Elouard. *Géol. Hydrogéol. Sénégal,* p. 220, pl. I, fig. 13-16 (pars).
1963 *Ostrea (Cymbulostrea) multicostata* Freneix and Gorodiski. *Bivalves Eocènes Sénégal,* p. 47, pl. VI, fig. 3-7.

Twenty small and medium-sized left valves and some bivalve specimens, of which only a few are well preserved, the others being rather fragmentary. Left valve inequilateral subtriangular to suboval in shape, more high than long, with L/H ratio between 70% and 77%, not very convex, with maximum convexity in the medio-dorsal region, declining more steeply towards the anterior margin than towards the posterior one. Anterior margin weakly convex, meeting the ventral margin in a broad arc; posterior margin initially concave and then becoming convex and meeting the curvilinear ventral margin more ventrally than does the anterior margin. Surface asymmetrical owing to a greater development of the posterior side. Umbo rather broad, opisthogyre, truncated and not folded on the ligament area. Ornament comprising about 30 dichotomous costae, rather close, separated by deep sulci. Leaving the umbonal regional, where they are closer and more slender, they follow the curvature of the umbo itself, opening fanwise and bifurcating with increasing frequency towards the ventral margin. Growth lamellae barely visible.

Internal surface with rather pronounced and regular concavity; semilunar muscle scar, deep, with slightly concave dorsal margin, situated ventrally and posteriorly. Ligament area with length similar to height.

Dimensions —

		l.v.	l.v.	l.v.	r.v.
Height	mm	62 ;	32.5 ;	27 ;	23
Length	mm	47.5 (77%);	24 (74%);	19 (70%);	18 (78%)

Remarks — The dimensions of the specimens examined range from large to small; the former resemble more the Asiatic specimens recognised by Vialov and by other authors who have studied this region; the others largely resemble those originating from Africa. Also, the present large specimens, like those of Vialov but unlike the types of the Paris basin, have an undulating inferior margin to the ligament area and the costae broaden towards the ventral margin.

O. multicostata Deshayes is a very variable species; some individuals examined have an oval shape, some are more elongate and with undulate margins, while others exhibit antero- and postero-ventral broadening and represent transitional forms to the variety *O. multicostata* var. *schirabadica* Vialov, figured by Vialov, (1948, plate XXVIII, fig. 1).

In 1930 Yang Kieh reproduced (plate VI, fig. 8, 9) juvenile specimens from North Afghanistan which were identical with the forms of lesser dimensions studied by the present author, and with an adult specimen (plate VII, fig. 1) of the same zone, very similar to the larger specimens.

Salvan (1954, plate III, fig. 1, 2, 10, 11) has illustrated forms with prominent concentric lamellae which confer on the rather prominent radial costae a particularly scaly aspect which is absent in the specimens under examination.

Vialov, in his notes (1948, p. 64) clarifies misunderstandings which have arisen about the species in question as a result of arbitrary and erroneous attributions, and provides useful comparisons with morphologically related species: *O. strictiplicata* Raulin & Delbos, *O. turkestanensis turkestanensis* Romanovkiy, *O. turkestanensis baissunensis* Böhm. *Ostrea multicostata* Deshayes differs from these in its lower convexity and consequently in a lesser valve thickness; also in the truncated umbo, the rather dense rounded branching costae and the overall narrower shape.

Occurrence — *O.* (*Cymbulostrea*) *multicostata* Deshayes is distributed in the Alai stage of the Tajik Depression. The type originates from Cuisien in the Paris Basin, and the species is widespread in the Eocene of Northern Europe, in France, in England, in Belgium, in Russia, Algeria, Tunisia, Egypt. It occurs also in the Lower and Middle Eocene of Senegal, India, Afghanistan, Pakistan, and in the Middle Eocene in Morocco. According to Yang Kieh this form is fairly characteristic of the Middle Eocene.

Locality — Mountains S. of Tashkurgan (61 AD-59/5). W. slope of Shiboglu Kotal (61 AD-58). 4 km S. of Ali Abad (61 AE-91/2). 8 km S. Ali Abad (61 AE-92). Ambar Koh (61 AE-89/7).

Subgenus **Flemingostrea** Vredenburg, 1916

Ostrea (Flemingostrea) schurabica Vialov, 1937

Pl. 32, fig. 4

1937 *Ostrea schurabica* Vialov. *Ostreids Ferghana*, p. 27, pl. XIX, fig. 1, 12; pl. XX, fig. 8-10.
1948 *Ostrea (Flemingostrea) schurabica* Vialov. *Ostreids Tajik*, p. 77, pl. XXXVIII, fig. 8-10.

One bivalve specimen, of medium size, moderately preserved. Shell inequivalve, swollen, with acute umbo extending beyond the cardinal margin. Left valve slightly inequilateral with shape from subcircular to suboval, slightly more high than long, with L/H ratio generally about 94%, very convex, with maximum convexity in the medio-dorsal region, declining more rapidly on the anterior margin than on the posterior margin. Anterior margin slightly convex, elongate, connecting with the ventral margin in a broad arc; posterior margin very convex, passing smoothly into the slightly curvilinear ventral margin. Surface receding in the antero-ventral region, more expanded in the postero-ventral region. Umbo small with pointed apex, not separated from the rest of the surface, folded towards the posterior margin and not recurved on the ligament area. Ornament comprising concentric growth lamellae, incised, arranged irregularly, denser in the medio-dorsal region of the valve. In addition to these there are about three radial costae, broad, ill-defined, discontinuous, which assume the appearance of swollen protuberances as they intersect the concentric lamellae.

Internal surface very hollowed-out, particularly beneath the ligament area, regular; muscle scar well-defined, semilunar, eccentric, situated in the postero-ventral half of the valve. Ligament area elongate, oblique, with a central depression, limited by two rather high lamellose margins.

Right valve flat, with shape corresponding approximately with that of the left valve. The margins leave the umbo at an obtuse angle; the anterior one is slightly convex and the posterior one is straight and oblique; they join the curvilinear ventral margin in a broad arc. Ornament comprising concentric growth lamellae more regular than on the left valve and swollen proturberances resulting from the intersection of the lamellae with three radial costae corresponding to those of the other valve and more developed.

Internal surface slightly concave, regular, with muscle scar evident, semilunar, situated in the postero-ventral region. Ligament area almost flat, greatly elongated along the posterior margin.

Dimensions —

		l.v.	r.v.
Height	mm	36 ;	30
Length	mm	34 (94%) ;	29 (97%)
Thickness	mm	17.5 (48%);	7 (23%)

Remarks — The only specimen examined strongly resembles those figured by Vialov (1937 b, 1948), but does not exhibit on the surface the slender and delicate radial striations which, according to the author of this species, should complete its original and characteristic ornament. No species of *Ostrea* from Central Asia shows any resemblance to *Ostrea schurabica* Vialov.

According to Vialov, in the Tajik Depression only isolated and incomplete specimens have been found, but their peculiarities correspond precisely with the original material from Ferghana.

Occurrence — *O.* (*Flemingostrea*) *schurabica* Vialov has been recorded in the Tajik Depression and in Ferghana, always in the first metre above the base of the Upper Turkestan stage.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Subgenus **Solidostrea** Vialov, 1948

Ostrea (Solidostrea) hemiglobosa Romanovskiy, 1884

Pl. 33, fig. 1; Pl. 34, fig. 1

1884 *Ostrea hemiglobosa* Romanovskiy. *Geol. Turkestan*, Lief. II, p. 26, pl. IV, fig. 1; pl. V, fig. 1.
1938 *Ostrea gigantica* Cox. *Eocène Afghanistan*, p. 39, pl. V, fig. 5 a-b (not Solander).
1948 *Ostrea* (*Solidostrea*) *hemiglobosa* Vialov. *Ostreids Tajik*, p. 14, pl. III-VI.

One well-preserved left valve and one large fragmentary right valve. Left valve subequilateral, massive, subcircular in shape, with similar length and height, very convex, with the point of maximum thickness (approx. 58 mm) at about half the height of the valve, decreasing uniformly on the anterior, posterior and ventral margins, but more abruptly on the dorsal margin, as far as can be ascertained from the specimen under examination, which is mechanically distorted. Anterior margin initially slightly oblique, becoming strongly convex and passing uniformly into the ventral margin; posterior margin initially straight, then convex and joining the strictly curvilinear ventral margin in a broad arc.

Ornament comprising undulating concentric lamellae, weakly imbricate, very irregularly spaced and notably denser towards the ventral margin; there is no trace of radial costae.

Umbo rather broad, flattened, straight, not projecting above the ligament area, not distinguished from the rest of the surface.

Internal surface regular, shallow, with distinct semicircular muscle scar, very deep-set and situated posteriorly at about half the height of the valve. Ligament area very low, in the form of an obtuse triangle, with a rather deep triangular central depression limited by long margins in relief; the ventral margin of this dimple projects particularly in the anterior part.

Right valve equilateral, subcircular in shape, also massive but with lesser thickness than the left valve; moderately convex. The margins continue regularly, concentrically delineating the circumference. Umbo broad, straight, truncated in a characteristic manner. Ornament consisting of undulating concentric lamellae, well spaced, and of some irregular folds.

Internal surface not very deep, piriform; muscle scar not visible.

Dimensions — Height mm 140 (98%)
Length mm 142

Remarks — The Afghan specimens clearly show the specific characters, which consist essentially of notable convexity, truncated umbo, absence of radial ornament, and the convex surface of both valves. Thus they can be clearly differentiated from the other morphologically related species such as ***Gryphaea gigantica*** Solander, ***O. bellovacina trinkleri*** Böhm, ***O. kalizkyi*** Vialov, ***Platygena asiatica*** Romanovskiy with which Vialov (1948, p. 15) compares the species in question, citing similarities and differences.

Cox (1938) illustrated a typical specimen of the left valve, very similar to that under examination with regard to dimensions, shape and ornament.

In the Afghan specimens the muscle scar of the right valve is not visible, but in the figures of Vialov (pl. VI) it appears semilunar and very deep.

Occurrence — *O.* (*Solidostrea*) *hemiglobosa* Romanovskiy is distributed in the Suzak stage of the Tajik Depression. It has been found by Vialov in the same stage but on the north slope of the Trans-Alai range. It has been recorded by Cox in the Ypresian of the Northern Afghanistan.

Locality — Mountains S. of Tashkurgan. 61 AD-59/8.

Subgenus **Turkostrea** Vialov, 1936

Ostrea (Turkostrea) afghanica Vialov, 1938

Pl. 33, fig. 3, 4

1938 *Ostrea afghanica* Vialov. *Fatina and Turkostrea*, p. 17.
1938 *Ostrea multicostata* var. *strictiplicata* Cox. *Eocène Nord-Afghanistan*, p. 32, pl. V, fig. 1 a-b, 2 (pars, non Raulin & Delbos).
1948 *Ostrea* (*Turkostrea*) *afghanica* Vialov. *Ostreids Tajik*, p. 60, pl. XXV, fig. 1-3.

Two bivalve specimens, twenty-five moderately preserved left valves, of medium dimensions. Shell of shape ranging from swollen to broadly ovoidal, with umbo sometimes acute and projecting beyond the cardinal margin, sometimes by contrast truncated in the area of attachment. Left valve slightly inequilateral, more high than long, with L/H ratio between 78% and 86%, rather convex, with maximum convexity situated in the medio-umbonal region, steeply decreasing towards the sides. Anterior and posterior margins weakly convex, joining the curvilinear ventral margin in a regular arc. Surface asymmetrical, more expanded in the postero-ventral region, receding anteriorly.

Ornament comprising twenty rather close radial costae, incised, broadening somewhat towards the ventral margin, dividing dichotomously repeatedly. The dichotomous division gives rise to two or more secondary costae of roughly similar size to the primaries, contrary to what is generally observed in the other species of *Turkostrea* distributed in the same horizon, which have smaller secondary costae than the primaries. The costae diverge in a fan from the umbo; in the central zone of the valve they are thus almost straight, while they curve slightly forwards in the anterior region and much more strongly backwards in the posterior region, where they are also more slender and close together. Growth lamellae which are barely discernible give the costae a scaly aspect.

Umbo more or less developed, acute, convex, but not separated from the rest of the surface, and not gryphoide.

Internal valve surface not visible in our specimens and not yet noted in the literature.

Right valve inequilateral, with shape approximately corresponding to that of the left valve and with appreciably lesser convexity. The margins leave the umbo at an obtuse angle, straight and oblique, the anterior one being shorter and the posterior one longer, they meet the curvilinear margin in a broad arc. Ornament comprising concentric growth lines, very dense and somewhat lamellose.

Dimensions —	Height	mm 50 ;	35 ;	30
	Length	mm 40 (80%);	27.4 (78%);	26 (86%)

Remarks — The specimens examined mostly correspond precisely with the diagrams of the species given by Vialov (1948); they have however somewhat lesser dimensions and are more flattened owing to the lesser convexity of the right valve. In 1938 Cox illustrated many specimens attributed by him to *O. multicostata* var. *strictiplicata*; in particular those in figs. 1 a, 1 b, 2, of pl. V, included in the synonymy of *Ostrea afghanica* by Vialov, are very similar to the specimens under examination, both in their left and their right valves.

According to the author of the species and according also to the observations of the present worker, *O. afghanica* seems to be very close to the group of *O. turkestanensis turkestanensis* Romanovskiy. This latter is however distinguished by its much more pronounced convexity, by the restriction of the preumbonal region of the left valve, by the strong development and by the character gryphoide of the umbo. Between these two extreme types there is a series of specimens of intermediate characters; they constitute the subspecies *O. turkestanensis baissunensis* Böhm, and form a link between *O. afghanica* and *O. turkestanensis turkestanensis*.

Occurrence — *O.* (*Turkostrea*) *afghanica* Vialov has so far been recorded only in the Alai stage in Northern Afghanistan and in the Tajik Depression.

Locality — W. slope of Shiboglu Kotal (61 AD-58). Mountains S. of Tashkurgan (61 AD-59/1). Ali Abad (not in situ) (61 AE-90). N. of Kalafgan (61 AE-65; 61 AE-66).

Ostrea (Turkostrea) cizancourti Cox, 1938

Pl. 34, fig. 2; Pl. 35, fig. 1

1938 *Ostrea turkestanensis* var. *calvata* Vialov. *Fatina and Turkostrea,* p. 18.
1938 *Ostrea cizancourti* Cox. *Eocène Afghanistan,* p. 37, pl. IV, fig. 2-4.
1948 *Ostrea* (*Turkostrea*) *cizancourti* Vialov. *Ostreids Tajik,* p. 62.

Thirty left valves, of various dimensions, moderately preserved. Valve inequilateral, subtriangular, more high than long, with L/H ratio uniform at about 64%; narrow and very convex in the umbonal region, declining with variable slope on the two sides. Anterior margin thick and lamellose, joined to the ventral margin in an obtuse angle; posterior margin more slender and less extended, passing uniformly into the ventral margin. The course of the margins depends on the torsion of the umbo. Surface asymmetrical, presenting two differently developed lobes on the sides, separated sometimes by a weak sulcus from the rest of the surface. In most of the specimens the posterior side is more developed. Umbo generally very recurved, almost always opisthogyre. Ornament comprising twenty rounded radial costae, close, slender and not very pronounced, but accentuated in the umbonal region and diminished towards the ventral part of the valve; denser and more evident concentric lamellae towards the ventral margin.

Ligament area covered in part by the umbo, of subrectangular shape, more long than high, with h/l ratio between 41% and 72%; oblique in valves with opisthogyre umbones, having a horizontal course in those with orthogyre umbones. Internal surface regularly smooth, deep, with broad muscle scar, semicircular, slightly hollowed, not always visible, situated in the postero-ventral part of the valve.

Dimensions —	Height	mm 70.6 ;	59 ;	34
	Length	mm 43.7 (62%);	38 (64%);	23 (67%)

Remarks — Of the specimens examined, those of medium dimensions are near to the typical specimens illustrated by Cox (1938). They exhibit posterior expansion, gryphoide umbo, which is folded towards the posterior side, radial costae accentuated only in the umbonal region, oblique ligament area, and deep internal cavity. In the other specimens the smaller or larger dimensions obscure or even somewhat distort these characters. The largest forms have a massive umbonal region, a lesser asymmetry of the valve, barely visible costae even on the umbo; these variations in the typical characters are visible also in fig. 2, pl. IV of Cox (1938).

The *O. cizancourti* Cox approaches *O. turkestanensis* Romanovskiy, but has a more asymmetrical shell and lacks deep and continuous radial costae. The *Fatina beldersaiensis beldersaiensis* (Gorizdro, partim Vialov) is certainly morphologically allied to the species in question, but is distinguished by having a broader umbonal region, by a lesser asymmetry of the valve, and by the absence or the lesser evidence of the two lateral folds.

Finally, *Fatina beldersaiensis romanowskii* (Böhm) differs from the *Ostrea* under consideration not only in the characters already mentioned, but also by the presence of radial costae on the whole of the surface.

Occurrence — *O.* (*Turkostrea*) *cizancourti* Cox has been recorded from the lower part of the Alai stage, in the Gulf of Ferghana and in the Tajik Depression. The specimens described by Cox originate from Northern Afghanistan, in beds of Alai age (Zaverzad, Ali Abad and Tashkurgan).

Locality — Valley N. of Hugi Jangal (Taluqan) (61 AD-55/2). W. slope of Shiboglu Kotal (61 AD-58). Mountains S. of Tashkurgan (61 AD-59/1). N. of Kalafgan (61 AE-66). Ambar Koh (61 AE-89/7). Ali Abad (not in situ) (61 AE-90). 8 km S. of Ali Abad (61 AE-92; 61 AE-10/1).

Ostrea (Turkostrea) khaudaguensis Vialov, 1948

Pl. 32, fig. 5

1948 *Ostrea* (*Turkostrea*) *khaudaguensis* Vialov. *Ostreids Tajik*, p. 63, pl. XXVI, fig. 7-12.

About sixty left valves and eight right of various shapes and of small dimensions, often broken and in a very poor state of preservation. Valve inequilateral, shape ranging from subtriangular to suboval, more high than long, with L/H ratio generally about 72%, more or less convex. Anterior margin gently concave; posterior margin more developed than anterior and convex; ventral margin curvilinear. Surface very convex, with convexity sometimes so pronounced as to appear as a keel in the median region, lowering gently on the anterior margin, but rising almost vertically on the posterior margin. Ornament comprising small radial costae, rounded, projecting slightly, which thicken towards the central margin, becoming dichotomous; they are more slender, prominent and closer together between the median pseudo-keel and the postero-ventral margin.

Umbo slightly recurved, gryphoide with pointed apex.

Internal surface with regular concavity, smooth, shallow; semilunar muscle scar, small, situated in the postero-ventral part of the valve; ligament area reduced, barely visible.

Right valve flat or weakly convex, inequilateral, shape ranging from subtriangular to suboval. Ornament comprising close fine concentric striations and irregular concentric folds. Internal surface almost flat, smooth; small semilunar muscle scar, situated in the postero-ventral part of the valve; ligament area barely visible.

Dimensions —

		l.v.	l.v.	l.v.	r.v.
Height	mm	31.6 ;	25 ;	20.6 ;	19
Length	mm	23 (72%);	19 (76%);	15.6 (72%);	15 (73%)

Remarks — Vialov considers as fundamental the presence of a keel from which the costae stand out with distinctly different characters on the two sides, becoming more slender towards the ventral margin. The specimens examined exhibit a very indistinct keel, or line of maximum convexity, running from the umbo to the postero-ventral corner, from which the surface of the valve declines in dissimilar ways on the two respective margins. The same phenomenon occurs in the remaining specimens illustrated by Vialov (pl. XXVI); only in a few of them is the keel more accentuated.

All of the other characteristics correspond exactly however to those described by Vialov, and consequently the specific attribution appears to be justified. The species is certainly very variable in convexity, shape and dimensions, as is observable both in the specimens under examination and in those illustrated by Vialov (1948).

Occurrence — *O.* (*Turkostrea*) *khaudaguensis* Vialov has been recorded so far only in the Lower Alai at Khaudag in the Tajik Depression.

Locality — W. slope of Siboglu Kotal (61 AD-58). Valley N. of Hugi Jangal (61 AD-55/1, 61 AD-55/2). Mountains S. of Tashkurgan (61 AD-59/5). Ambar Koh (61 AE-89/7).

Ostrea (Turkostrea) turkestanensis turkestanensis Romanovskiy, 1878

Pl. 33, fig. 2; Pl. 34, fig. 3; Pl. 35, fig. 2, 3

1878 *Ostrea turkestanensis* Romanovskiy. *Geol. Turkestan*, Lief. I, p. 112, pl. X, fig. 2 a-c; pl. XI, fig. 3 a-b; pl. XII, fig. 2, 2 a.
1903 *Ostrea turkestanensis* Böhm. *Eocäne Ferghana*, p. 99.
1910 *Ostrea turkestanensis* Sokolow. *Etage Ferghanien*, p. 60, text-fig. 2, 3.
1910 *Ostrea strictiplicata* Douvillé. *Observations Ostréides*, p. 641, pl. X, fig. 6-9 (non Raulin and Delbos).
1930 *Ostrea multicostata strictiplicata* Kieh Yang. *Ostrea Eocène*, p. 89 (pars), pl. VII, fig. 2 a-c, 4 a-b.
1933 *Ostrea turkestanensis* Böhm. *Palaeogene Ost-Turkestan*, p. 103, pl. IX, fig. 5.
1937 *Ostrea strictiplicata* Vialov. *Ostreids Ferghana*, p. 13, pl. VIII, fig. 1; pl. IX, fig. 1, 2.
1938 *Ostrea multicostata* var. *strictiplicata* Cox. *Eocène Afghanistan*, p. 32, pl. IV, fig. 5, 6; pl. V, fig. 4 a-b.
1948 *Ostrea turkestanensis* Vialov. *Ostreids Tajik*, p. 52, pl. XXII, fig. 2-4; pl. XXIII, fig. 7 a-c.
1962 *Ostrea turkestanensis* Gekker, Osipova, Bel'skaya. *Paleogen. Ferghana*, pl. V, fig. 1-3; pl. VI, fig. 1, 2 a-b.

About thirty left valves, seven right valves and two bivalve specimens, in part well preserved, in part broken and fragmentary. Shell inequivalve, oval or subtriangular, massive with strongly convex and very narrow umbonal region. Left valve inequilateral or subequilateral, subtriangular, more high than long, with L/H ratio between 66% and 76%. Convexity very strong in the median region, rapidly and steeply decreasing towards the anterior and posterior sides; profile longitudinal with regular and strong curvature. Anterior margin weakly concave, embracing about 35% of the total height of the valve and joining the ventral margin in an obtuse angle, tightly curved; posterior margin strongly concave, about as long as the anterior margin and meeting the ventral margin in an obtuse angle. Dorsal surface more developed posteriorly than anteriorly, expanded in some specimens to form a narrow lobe limited by a weak sulcus in the postero-ventral region. Ornament consisting of 20-25 radial costae, rounded, well defined, dichotomous, coarsening markedly before dividing. Concentric growth lamellae more noticeable in the ventral region, giving the costae a scaly appearance.

Umbo slender, strongly convex, with apex inclined either forward or also backwards.

Internal surface smooth, regular, shallow, muscle scar broad, semicircular, situated at about 2/3 of the height of the cavity. Ligament area of subrectangular shape, considerably more high than broad, with ratio between 57% and 63%, covered slightly by the umbo, with a broad depression limited by two elevated and narrow lateral zones.

Right valve massive, inequilateral, slightly convex, subtriangular in shape owing to the presence of two antero- and postero-ventral alar expansions, separated from the rest of the surface by a depression. Anterior margin very short, forming a broad arc with the ventral margin; posterior margin slightly concave, joining the ventral margin in a regular arc. Ornament consisting of concentric lamellae, close and slender, and of irregular folds. Ligament area rather extended with the ventral margin projecting and sinuous. Internal surface smooth, with slight and regular concavity.

Dimensions —

		l.v.	l.v.	l.v.	l.v.	r.v.
Height	mm	67 ;	63.2 ;	56.3 ;	35.5 ;	46
Length	mm	47 (70%);	48 (76%);	33.6 (66%);	25.5 (72%);	44 (95%)

Remarks — Some of the specimens examined are high, of oval shape and correspond well with the specimens reproduced in the fig. 2 a-b of pl. XXII of Vialov (1948), from the Tajik Depression. Other rounded and deltoid specimens exhibit a greater resemblance to fig. 4 a-b of the same plate; yet others are swollen, with a particularly gryphoide umbo, and are more similar to fig. 7 a-b of pl. XXIII.

The forms from Ferghana illustrated by Gekker, Osipova, Bel'skaya (1962) and by Vialov (1937) have larger dimensions and show more marked variations; they are elongated or rounded in a particular way, or are very massive with a gryphoide umbo. All of the specimens examined have however the following characteristics in common: the strong convexity, the gryphoide umbo, the large pronounced costae, dichotomous, and the asymmetry of the left valve.

In 1948 Vialov (p. 54) reviewed and resolved several points raised by the previous authors about this species. He separated *Ostrea turkestanensis turkestanensis* Romanovskiy from *Ostrea multicostata strictiplicata* Raulin & Delbos, noted the specific differences and provided numerous and useful comparisons with species closely related morphologically, such as *O. multicostata* and *Fatina boehmi*. The many specimens examined by the present author have permitted the confirmation of all of the observations of Vialov (1948, p. 54), leading to the inclusion through synonymy of *O.* (*Turkostrea*) *turkestanensis turkestanensis* forms which Cox (1938) had attributed to *O. multicostata* var. *strictiplicata*; only the specimens illustrated in fig. 1, 2, plate V are excluded, on account of its resemblance to specimens of *O. afghanica*.

Occurrence — *O.* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy has been recorded in the Alai stage of Ferghana, from the Tashkent region, from the Alai and Trans-Alai ranges and from other parts of Central Asia, from Kasgar and from Afghanistan; it has been found in the Lower and Middle Eocene of Southern Iran, France and Northern Africa.

Locality — Ambar Koh. 61 AE-89/7.

Ostrea (Turkostrea) turkestanensis alaica Vialov, 1938

Pl. 36, fig. 1-3

1910 *Ostrea turkestanensis* Sokolow. *Etage Ferghanien*, p. 60 (pars), text-fig. 1.

1930 *Ostrea multicostata* var. *strictiplicata* Kieh Yang. *Ostrea Eocène*, p. 89 (pars), pl. VII, fig. 3.

1938 *Ostrea turkestanensis* var. *alaica* Vialov. *Fatina and Turkostrea*, p. 17.

1948 *Ostrea* (*Turkostrea*) *turkestanensis* var. *alaica* Vialov. *Ostreids Tajik*, p. 56, p. XXII, fig. 1.

Ten left valves of medium and small dimensions, well preserved. Subequilateral valve of triangular shape, owing to the presence of two ventral alar expansions, more high than long, with height in many specimens about double the length, moderately convex, with maximum convexity in the medio-dorsal region, declining with the same slope on the posterior and anterior sides. The anterior and posterior margins diverge symmetrically from the apex, meeting the ventral margin in an obtuse angle, determining equal lateral expansions on the two sides of the valve in the ventral half. The anterior margin is less spread than the posterior one; both are broad and lamellose. Ornament comprising twenty rounded radial costae, separated by shallow sulci, radiating from the umbonal region where they are particularly marked, but subdividing and disappearing towards the ventral margin, which is dentellated; there are concentric lamellae parallel to the ventral margin.

Umbo strongly recurved, generally orthogyre, in some cases prosogyre.

Ligament area subrectangular with length slightly greater than the height, and with a median depression limited by raised lateral zones. Internal surface regularly concave and rather deep; muscle scar not visible.

Dimensions —	Height	mm 76 ;	47.4
	Length	mm 48 (63%);	35.5 (75%)
	Thickness	mm 45 (59%);	33 (70%)

Remarks — Some of the specimens studied exhibit a very recurved umbo, an umbonal region separated more clearly from the rest of the surface and more narrow than that of the exemplars illustrated by Vialov (1948, pl. XXII, fig. 1) and by Jang Kieh (1930, pl. VII, fig. 3), but these characters (apart from the presence of the wings) are nevertheless precisely those which distinguish *O. turkestanensis alaica* from *O. turkestanensis turkestanensis.* These specimens may therefore be included with confidence in the subspecies in question, which represents a gradual passage from the type-species to *O. turkestanensis borgalensis* Vialov.

Occurrence — *O.* (*Turkostrea*) *turkestanensis alaica* Vialov has been recorded always in the Alai stage in the Ferghana, in the Tajik Depression, where it is scarce, and in the ranges of Alai and Trans-Alai.

Locality — Ambar Koh. 61 AE-89/7.

Ostrea (Turkostrea) turkestanensis baissunensis Böhm, 1899

Pl. 36, fig. 4-7

1899 *Ostrea baissunensis* Böhm. *Foss. Buchara,* p. 466, pl. XXIX, fig. 1 a-c, 2, 3.
1938 *Ostrea multicostata* var. *strictiplicata* Cox. *Eocène Afghanistan,* p. 32 pl. V, fig. 3.
1948 *Ostrea* (*Turkostrea*) *turkestanensis* var. *baissunensis* Vialov. *Ostreids Tajik,* p. 58, pl. XXIII, fig. 1, 4, 6; pl. XXIV, fig. 1 a-c, 2 a-c; pl. XXVI, fig. 2 a-b, 3 a-b.

Ten left valves, two large, the others of medium and small dimensions. Valve subequilateral, massive, subtriangular to suboval in shape, more high than long, with L/H ratio between 69% and 87%; moderately convex, with maximum convexity in the medio-dorsal region and usually declining on the two sides. Anterior margin weakly convex, meeting the ventral margin in a broad arc; posterior margin hollowed out beneath the umbo, becoming weakly convex and forming a broad arc with the curvilinear ventral margin. Surface almost symmetrical, exhibiting the same length along the whole of the height, reducing somewhat in the umbonal region; in the specimens with umbones slightly folded laterally it is slightly more developed in the postero-ventral part, disappearing in the antero-ventral part. Umbo massive, convex, overlying the ligament area without covering it.

Ornament consisting of about 22 rounded radial costae, well defined, rather slender, which radiate from the umbonal region, reaching as far as the ventral margin without attenuating; they are broad and well spaced in the central part of the surface, becoming denser anteriorly and posteriorly, particularly in the umbonal region, and repeatedly divide dichotomously giving rise to secondary costae as broad as the primaries. The barely visible concentric lamellae render the radial costae of somewhat scaly aspect.

Internal surface not visible in the present specimens. Ligament area subrectangular, more long than high, with a broad central depression bounded by raised lateral zones.

Dimensions —

Height	mm	77.3 ;	48 ;	44 ;	41.5 ;	31.2
Length	mm	53.8 (69%);	40.8 (87%);	37.5 (85%);	30 (72%);	22 (70%)

Remarks — The specimens under examination, like the numerous illustrations of the subspecies given by Vialov (1948), exhibit a certain variability in margin course and in the dimensional relationship. In all of them however the characteristics which distinguish this subspecies from the type-species *O. turkestanensis turkestanensis* Romanovskiy are very clear; height exceeding length, shape approaching symmetry, position of maximum valve length in the ventral third, convexity of left valve considerably less, umbo broader and less separated from the remainder of the surface and less gryphoide, denser costae which are slender and rounded.

This new subspecies of Vialov comprises a transitional form from the type-species to *O. afghanica* Vialov; it is easily distinguished from *O. multicostata* Deshayes by the prominent radial costae, the lesser convexity and the shorter development of the umbo in this latter.

Vialov, in instituting the subspecies in question, discusses the interpretations and erroneous attributions made by previous authors, i.e. Böhm, Gorizdro, Mikailoski, Sokolow and Janki. These authors had placed similar specimens in species of their own, such as *O. baissunensis* Böhm, or added them to other species, such as *O. turkestanensis* Romanovskiy, *O. strictiplicata* Raulin & Delbos, *O. multicostata* Deshayes, which as already shown are very different from *O. turkestanensis baissunensis.*

Böhm, for stratigraphical reasons, had considered *O. baissunensis* to be a Cretaceous form; Vialov later (1948) reported it in the Alai stage corresponding to the Middle Eocene.

Occurrence — *O.* (*Turkostrea*) *turkestanensis baissunensis* Böhm has been recorded from the Alai stage of the Tajik Depression, Kara-Tau, from the Tashkent region, and of Northern Afghanistan. Representatives of this subspecies are in the Grisba collection, as far as can be deduced from the photographs received from the Indian Geological Committee.

Böhm has recorded the subspecies in the Upper Cretaceous of Bukhara.

Locality — W. slope of Shiboglu Kotal (61 AD-58). Valley N. of Hugi Jangal (61 AD-55/1). 8 km S. of Ali Abad (61 AE-92).

Ostrea (Turkostrea) turkestanensis borgalensis Vialov, 1937

Pl. 37, fig. 1, 2

1937 *Ostrea strictiplicata* var. *borgalensis* Vialov. *Ostreids Ferghana*, p. 16, pl. X, fig. 1, 2.
1938 *Ostrea turkestanensis* var. *borgalensis* Vialov. *Fatina and Turkostrea*, p. 17.
1948 *Ostrea* (*Turkostrea*) *turkestanensis* var. *borgalensis* Vialov. *Ostreids Tajik*, p. 57, pl. XXIII, fig. 5.

Ten left valves of small and medium dimensions, moderately preserved. Valve subequilateral, subtriangular in shape, ovoid, more high than long, with L/H ratio between 50% and 63%, moderately convex, with maximum convexity in the medio-dorsal region, evenly declining on the two sides. Anterior margin oblique, broken in the specimens under examination, as a result of which the junction with the ventral margin is scarcely visible; posterior margin long, oblique and straight, forming a broad arc with the curvilinear ventral margin. The dorsal surface exhibits about the same length along the whole of the height. Umbo massive, convex and truncated. Ornament comprising radial costae, well defined in the central region of the valve, rounded, dichotomous, almost straight and broadening slightly, much weaker in the lateral regions and entirely eliminated in the vicinity of the anterior and posterior margins. Dense and scaly concentric lamellae readily visible particularly in the marginal regions and concentric folds repeated at broad and regular intervals.

Ligament area rectangular, more long than high, with l/h ratio between 55% and 72%, not covered by the umbo, with median depression limited by two rather broad raised lateral zones. Internal surface undulate, shallow, more hollowed-out beneath the ligament area, with prominent semilunar muscle scar situated in a postero-ventral position in the ventral third of the valve.

Dimensions —	Height	mm 73 ;	55.2 ;	46.5
	Length	mm 40.2 (55%);	35 (63%);	23.3 (50%)

Remarks — Of the specimens examined, the largest are similar to the individuals illustrated by Vialov and originating from the Ferghana basin; the smaller ones resemble the forms found in the Tajik Depression (Vialov, 1948), which have a more slender umbonal region compared with the first and also costae which broaden and disappear towards the ventral region.

All of the forms have in common an elongate and very narrow shape, a trapezoidal-shaped ligament area, projecting on the internal surface, a well-defined muscle scar in a ventral position, and the great symmetry of the valve;

these characters allow the distinction of *O. turkestanensis turkestanensis* Romanovskiy and the attribution to this new subspecies of Vialov.

In the institution of the subspecies Vialov queries whether there are sufficient parameters for the subspecies under appraisal to be an independent species. Nevertheless, the differences cited above are not such as to cancel the other characters which link *O. turkestanensis borgalensis* Vialov to the type-species, these being: the considerable thickness of the left valve, and the rounded prominent dichotomous costae which thicken appreciably before dividing. It is therefore still considered that there are insufficient characters for a separation to be made from *O. turkestanensis turkestanensis* Romanovskiy.

Occurrence — *O. turkestanensis borgalensis* Vialov has been recorded in the Alai stage in the Ferghana gulf and in the Tajik Depression.

Locality — Tashkurgan (61 AD-59/5). Ambar Koh (61 AE-89/7).

Ostrea sp. ind. Vialov, 1948

Pl. 37, fig. 3-5

1948 *Ostrea* sp. Vialov. *Ostreids Tajik,* p. 67, pl. XXVI, fig. 4-6.

Three moderately preserved left valves, small, of rather heterogeneous shape for them to be considered and described separately; they appear to coincide with the three specimens figured and described by Vialov as *Ostrea* sp.

First valve inequilateral, of pentagonal shape, very expanded towards the ventral margin, more long than high, with H/L ratio about 79%; weakly convex. Anterior margin straight, rectilinear, meeting the ventral margin in an obtuse angle; posterior margin with incompletely visible course, meeting the ventral margin in an obtuse angle, almost curvilinear. Umbo not very prominent, rather narrow, with a weak torsion towards the posterior region. Ornament comprising about 18 radial costae, dichotomous, rounded and not markedly projecting, diverging in a fan from the umbonal region, in which they are poorly visible owing to the removal of the shell. Concentric lamellae visible only in the anterior region of the valve, where the radial costae are slender and appear dense and scaly. Internal surface encrusted.

Second valve subequilateral, triangular in shape, more high than long, with L/H ratio about 70%, convexity accentuated in the medio-dorsal region, becoming perpendicular on the posterior margin, with slightly lesser slope on the anterior margin. Anterior margin broken, with scarcely visible course; posterior margin rectilinearly oblique, itself broken in correspondence with the postero-ventral junction. Umbo slightly recurved, gryphoide with pointed apex. Ornament comprising 16 radial costae, rather coarse, well defined, dichotomous, incised, which run from the umbo to the ventral margin without weakening; concentric lamellae confer on the costae a scaly appearance. Ligament area slightly oblique, triangular, more long than high, with h/l ratio about 66%, with a central zone limited by two higher zones. Internal surface hollowed-out beneath the ligament area, shallow and regular over the rest of the shell, not showing muscle scar.

Third valve inequilateral, subcircular in shape, more high than long, with L/H ratio about 85%, with medium convexity, becoming a maximum in the medio-dorsal region, and gently decreasing on the anterior margin and rapidly on the posterior margin. Anterior margin oblique, becoming convex and forming a broad arc with the ventral margin; posterior margin initially oblique, then convex, passing uniformly into the curvilinear ventral margin. Dorsal surface more developed in the anterior region. Umbo small, not very prominent and only slightly raised from the surface of the valve, slightly gryphoide and with pointed apex. Ornament of about 20 radial costae, small, rounded, poorly developed and not over the whole surface, dichotomous, diverging radially from the umbo; concentric lamellae evident particularly in the ventral region, dense and slightly scaly. Ligament area triangular, oblique, with h/l ratio uniform at about 50%. Internal surface shallow, regular, hollowed-out beneath the ligament area.

Dimensions —

		I	II	III
Height	mm	23.1 (79%);	29.7 ;	24
Length	mm	29 ;	20.8 (70%);	20.3 (85%)

Remarks — As Vialov also observed, the first specimen resembles *O. khaudaguensis* Vialov (pl. XXVI, fig. 10) in shape, but has smaller dimensions. It is distinguished also by the absence of a keel, but resembles the species in the character of the parallel costae in the posterior region of the valve.

The second specimen differs from *O. khaudaguensis* in the characters noted above, and also by a costal course resembling that of *O. turkestanensis turkestanensis*.

The third specimen has a swollen shape and is comparable to juvenile forms of *O. afghanica* Vialov, but it cannot be included with any certainly in this species.

Occurrence — *Ostrea* sp. Vialov has been recorded in the Alai stage of the Tajik Depression.

Locality — Ambar Koh. 61 AE-89/7.

Subclass HETERODONTA

Order VENEROIDA

Suborder LUCININA

Superfamily LUCINACEA Fleming, 1828

Family LUCINIDAE Fleming, 1828

Subfamily LUCININAE Fleming, 1828

Genus **Cavilucina** Fischer, 1887

Subgenus **Pegophysema** Stewart, 1930

Cavilucina (Pegophysema) thebaica (Zittel, 1883)

Pl. 38, fig. 1, 2

1883 *Lucina thebaica* Zittel. *Geol. Palaeont. Libya Aegypten*, p. 100.
1903 *Lucina thebaica* Oppenheim. *Alttertiärer Faunen Aegypten*, p. 128, pl. XIII, fig. 3, 3a.
1905 *Lucina thebaica* Newton. *Tertiary Somaliland*, p. 171, pl. XX, fig. 4, 5.
1920 *Lucina thebaica* Di Stefano. *Cret. Eocene Deserto Arabico*, p. 34, pl. IX.
1921 *Lucina thebaica* Stefanini. *Terziario Cirenaica*, p. 111.
1930 *Lucina thebaica* Cuvillier. *Nummulitique égyptien*, p. 84.
1933 *Lucina thebaica* Cuvillier. *Contr. Nummulitique égyptien*, p. 15, pl. III, fig. 1, 13, 23.
1938 *Cavilucina (Pegophysema) thebaica* Chavan. *Classification Lucines*, p. 120.
1942 *Lucina thebaica* Rossi. *Moll. Paleogen. Sirtica*, p. 173.
1952 *Cavilucina (Pegophysema) thebaica* Tessier. *Paléont. Ouest Sénégal*, p. 338, pl. XXV, fig. 16, 17.
1956 *Lucina thebaica* Giannini. *Eocene Migiurtinia*, p. 28, pl. II, fig. 3.

Two internal bivalve casts, of medium dimensions, adequately preserved, rather thick, with Th/L ratio between 62% and 56%. Shell equivalve, subequilateral or slightly inequilateral, subrhomboidal to suboval in shape, very convex and extended transversally, with H/L ratio between 70% and 77%. Antero-dorsal margin long and rather oblique, joined to the anterior margin almost in a right angle by a very narrow arc, broadly curved, passing indistinctly into the ventral margin. Postero-dorsal margin short and straight, slightly inclined with respect to the horizontal, forming an acute angle with the posterior one, which passes curvilinearly into the ventral one.

Surface slightly asymmetrical with anterior side shorter and conical, posterior one more expanded and higher. Posterior region crossed by a keel or line of maximum oblique convexity, running from the umbo to the postero-ventral contact to delineate a narrow weakly concave area near the posterior margin. Ornament visible, in part, in one specimen, comprising regularly spaced concentric striae.

Umbones robust, slightly pointed at their extremity, well defined, slightly forward in position and very recurved laterally. Lunule small but well defined, area narrow and elongate.

Dimensions —

		I	II	Tessier
Length	mm	36 ;	32 ;	54
Height	mm	28 (77%) ;	22.5 (70%);	41 (75%)
Thickness	mm	22.5 (62%);	18 (56%) ;	36 (66%)

Remarks — The specimens under examination correspond very well to the description and illustration of the species given by Tessier (1954, p. 338, pl. XXV, fig. 16, 17) in general shape, in the proportion of the sides and the dimensional ratios, in the course of the umbones and of the posterior keel, and in the ornament; they have however very much smaller dimensions.

They differ somewhat from the cast illustrated by Oppenheim (1903, pl. XIII, fig. 3) resembling more the description given (1903, p. 128) by this author which, as Cuvillier (1933) remarked, does not correspond to the illustration, but is sufficiently precise to be considered as the diagnosis of this species.

The Egyptian specimens studied by Cuvillier (1933) have, in comparison with the Afghan ones, larger dimensions, a more rectangular shape, an appreciable thickness and more prominent umbones. Giannini (1956) illustrates (pl. II, fig. 3) a very rounded specimen, poorly developed lengthwise, and in effect very similar to the cast illustrated by Oppenheim.

The nearest form to the species in question is *Pterolucina pharaonis bialata* (Bellardi), from which it however differs in having less dilated anterior and posterior sides, not truncated, and differing from one another; also in the anterior and posterior margins which continue uniformly, becoming confused with the ventral margin; thirdly, it has a greater convexity.

The generic and subgeneric nomenclature results from the work of Chavan (1938) on the classification of the *Lucinidae*.

Occurrence — *C.* (*Pegophysema*) *thebaica* (Zittel) has been recorded in the Ypresian of Egypt and Senegal, in the Lower and Middle Eocene of Sirtica, of Migiurtinia, and Arab desert, in the Middle Eocene of Cyrenaica.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Genus **Pterolucina** Chavan, 1942

Pterolucina cf. **menardi** (Deshayes, 1824)

Pl. 38, fig. 3

cf. 1824 *Lucina menardi* Deshayes. *Foss. envir. Paris*, vol. I, p. 94, pl. XVI, fig. 13, 14.
cf. 1904-1906 *Phacoides menardi* Cossmann and Pissarro. *Eocéne envir. Paris*, pl. XXIV, fig. 82-10.

cf. 1938 *Cavilucina* (*Pegophysema*) *menardi* Chavan. *Classification Lucines*, p. 119.
cf. 1942 *Phacoides menardi* Rossi. *Moll. Paleogen. Sirtica*, p. 174, pl. XI, fig. 1.
cf. 1942 *Pterolucina menardi* Chavan. *Deux groupes Lucinidae*, p. 62.

One internal bivalve cast, of medium size, not very well preserved, fragmentary in the postero-ventral region. Shell equivalve, equilateral, spherical, not very thick, with Th/L ratio averaging about 54%, slightly more long than high, with H/L ratio averaging about 97%. Antero- and postero-dorsal margins oblique, straight, almost symmetrical, forming an obtuse angle with the respective anterior and posterior margins; these latter join the curvilinear ventral margin in an arc. Surface divided into three parts, a central more convex part and two more flattened lateral parts, by means of two keel-like features, the posterior one of which is more accentuated; they diverge symmetrically from the umbo and broaden weakening as far as the antero- and postero-ventral contacts. Ornament not preserved; only traces of weak folds are observed.

Umbones small, not pronounced, acute, almost central and weakly folded forwards. Lunule not visible in the specimen under examination; very long semilunar area.

Dimensions —	Length	mm	32.8
	Height	mm	32 (97%)
	Thickness	mm	18 (54%)
	Apical angle		113°

Remarks — The specimen under examination is very similar to the illustration of the species given by Rossi (1942, pl. XI, fig. 1) in shape, and in the course of the keel and of the umbo. The imperfect state of preservation does not allow a firm identification, however.

The species under examination has some resemblance to *Pterolucina mokattamensis* (Oppenheim), from which it is distinguished by smaller size, greater relative thickness, and the separation of the anterior and posterior sides (which are not depressed) from the rest of the surface by means of keels.

Occurrence — *P. menardi* (Deshayes) has been recorded in the Middle Eocene of France and Sirtica, and also probably in Egypt.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Pterolucina cf. **mokattamensis** (Oppenheim, 1903)

Pl. 38, fig. 5

cf. 1903 *Lucina mokattamensis* Oppenheim. *Alttertiärer Faunen Aegypten*, p. 135, pl. XIV, fig. 7-9; pl. XVI, fig. 5.
cf. 1921 *Lucina mokattamensis* Stefanini. *Terziario Cirenaica*, p. 113, pl. XVI, fig. 5.
cf. 1942 *Lucina mokattamensis* Rossi. *Moll. Paleogen. Sirtica*, p. 173, pl. X, fig. 2.

An internal bivalve cast, medium sized, slightly deformed as a result probably of compression (one valve had slid upon the other). Shell equivalve, subequilateral, subcircular in shape, with L/H ratio averaging unity, slightly convex. Antero- and postero-dorsal margins oblique, curvilinear, joined in a wide angle across the anterior and posterior margins with the closely circular ventral margin. Anterior and posterior sides compressed like wings.

On the surface there is visible a radial sulcus which runs from the umbo to the posterior margin, forming a narrow subtriangular area. Ornament comprising traces of concentric lamellae.

Umbones small, with pointed apices, slightly projecting.

Dimensions — Length	mm	43.5
Height	mm	43.5 (100%)
Thickness	mm	18 (41%)
Apical angle		132°

Remarks — The specimen under examination, although deformed by compressions which have caused one valve to slide upon the other, can nevertheless be identified on the basis of ist general form as *Pterolucina mokattamensis* (Oppenheim). It is similar to the illustration of the species given by Rossi (1942, pl. X, fig. 2) in dimensions, form, the course of the pointed apices, and the depression of the anterior and posterior sides.

Oppenheim in 1903 illustrated incomplete forms, in which however the acute and inconspicuous umbo directed towards the anterior margin is visible; two oblique keels leave this obliquely and pass to the antero- and postero-ventral contact, separating a posterior depressed area and a less defined anterior area which in the specimen under examination is not distinguishable.

Occurrence — *P. mokattamensis* (Oppenheim) has been recorded in the Lower and Middle Eocene of Egypt, Cyrenaica, in the Eocene of Migiurtinia, of Morocco and in the Middle Eocene of Sirtica.

Locality — Ambar Koh. 61 AE-89/3.

Pterolucina pharaonis pharaonis (Bellardi, 1854)

Pl. 38, fig. 6

1854 *Lucina pharaonis* Bellardi. *Nummulitico Egitto*, p. 190, pl. II, fig. 12.
1854 *Lucina pharaonis* d'Archiac. *Nummulitique Inde*, p. 354.
1854 *Lucina wicaryi* d'Archiac. *Ibidem*, p. 240, pl. XVII, fig. 5.
1854 *Lucina subwicaryi* d'Archiac. *Ibidem*, p. 241, pl. XVII, fig. 6.
1854 *Corbis elliptica* d'Archiac. *Ibidem*, p. 237, pl. XVI, fig. 13.
1854 *Corbis subelliptica* d'Archiac. *Ibidem*, p. 238, pl. XVI, fig. 14.
1862 *Lucina hoevusi* Coquand. *Géol. Paléont. Constantine*, p. 269, pl. XXX, fig. 17, 18.

1903 *Lucina pharaonis* Oppenheim. *Alttertiärer Faunen Aegypten*, p. 124, pl. V, fig. 6; pl. XIII, fig. 1, 2.
1921 *Lucina pharaonis* Stefanini. *Terziario Cirenaica*, p. 112, pl. XVI, fig. 4.
1930 *Lucina pharaonis* Cuvillier. *Nummulitique égyptien*, pp. 85, 167, 287.
1931 *Lucina pharaonis* Cox. *Moll. Indian Eocene*, p. 72, pl. IV, fig. 8.
1934 *Lucina pharaonis* Desio. *Paleog. Sirtica e Fezzan orient.*, p. 90, pl. VI fig. 2.
1942 *Lucina pharaonis* Rossi. *Moll. Paleogen. Sirtica*, p. 171.
1946 *Lucina pharaonis* Tavani. *Eocene Cirenaica*, p. 179.
1951 *Anodontia pharaonis* Eames. *Pakistan Eocene*, p. 390.
1952 *Cavilucina (Pegophysema) pharaonis* Tessier. *Paléont. Ouest Sénégal*, p. 339, pl. XXV, fig. 21, 22.
1954 *Lucina* cf. *pharaonum* Salvan. *Invért. marocains*, p. 76, text-fig. 28.
1956 *Lucina pharaonis* Giannini. *Eocene Migiurtinia*, p. 28, pl. I, fig. 18.

Two internal bivalve casts, of relatively large size, rather well preserved. Shell equivalve, slightly inequilateral and of subcircular shape, with H/L ratio averaging about 87%, moderately convex, with maximum convexity in the medio-umbonal region, gently decreasing on the sides and more abruptly on the ventral margin. Antero-dorsal margins, anterior and ventral, continuing regularly one within the other so as to form a semicircumference. Postero-dorsal margin straight, slightly oblique and rather short, joined in a broad arc to the posterior one, which passes regularly into the curvilinear ventral one. Surface weakly asymmetrical, crossed by two radial lines of which the posterior one is the more visible; they diverge symmetrically from the umbo, extending respectively as far as the antero- and postero-ventral corners, separating two narrow areas. Anterior area very flattened with more rounded shape; posterior area larger, in the shape of an obtuse triangle, with the vertex situated in the point of contact between the posterior margin and the postero-dorsal one. Ornament preserved only in traces, represented by concentric lines which are more pronounced towards the ventral margin.

Umbones rather broad, inconspicuous, situated in the anterior half of the valve, relatively pointed, with adjoining apices. Lunule not visible; area rather broad and developed.

Dimensions —	Length	mm	40
	Height	mm	35 (87%)
	Thickness	mm	21.5
	Apical angle		133°

Remarks — The specimens examined are very similar to the illustration of the species given by Bellardi (1854, pl. II, fig. 12) in spite of being slightly shorter and rounded and lacking the lunule owing to its imperfect state of preservation. Bellardi (1854, p. 190) describes the lunule as being long, shallow and simple, and considers this, along with the founded shape of the shell, to be characteristic of the form.

In 1931 Cox included in this species various forms denoted by d'Archiac (1854) under various other names; they are in effect forms very closely related to the species of Bellardi.

The subspecies under examination has been attributed, like the subspecies *bialata* and the species *mokattamensis*, to the genus *Pterolucina* instituted by Chavan (1942); these forms agree in diagnostic characters with this new taxon of the *Lucinidae*, proposed for forms very similar to these.

Occurrence — *P. pharaonis pharaonis* (Bellardi) is one of the most widespread forms in the Upper and Middle Eocene of Egypt, Libya; in the Eocene of India, Migiurtinia, Arabia and Iraq. It is also known in the Lower Eocene of Algeria and of Morocco, in the Middle Eocene of Cyrenaica and in the Lower and Middle Eocene of Senegal. Cuvillier doubtfully signals it in the Oligocene of Cairo neighbourhood.

Locality — Ambar Koh. 61 AE-89/3.

Pterolucina pharaonis bialata (Bellardi, 1854)

Pl. 38, fig. 7, 8

1854 *Lucina bialata* Bellardi. *Nummulitico Egitto*, p. 191, pl. II, fig. 7.
1933 *Lucina pharaonis bialata* Cuvillier. *Contr. Nummulitique égyptien*, p. 14, pl. III, fig. 2, 3, 4.
1934 *Lucina pharaonis bialata* Desio. *Paleog. Sirtica e Fezzan orient.*, p. 91, pl. VIII, fig. 1.
1942 *Lucina pharaonis bialata* Rossi. *Moll. Paleogen. Sirtica*, p. 172.
1946 *Lucina pharaonis bialata* Tavani. *Eocene Cirenaica*, p. 180.
1956 *Lucina pharaonis bialata* Giannini. *Eocene Migiurtinia*, p. 28, pl. I, fig. 19, 20.

Two internal bivalve casts, of moderate size, rather well preserved, somewhat compressed, with Th/L ratio about 46%. Shell equivalve, subequilateral, ovate-subquadrangular in shape, very long with H/L ratio about 76%, moderately convex with maximum convexity in the medio-umbonal region, gently decreasing on the sides, then abruptly on the ventral margin. Anterior and postero-dorsal margins straight, slightly oblique, joined in a broad angle respectively to the anterior and posterior margins which descend almost vertically, merging with the long and arcuate ventral margin.

Surface slightly asymmetrical owing to the slightly anterior position of the umbo; it exhibits two very flattened and extended alar expansions in the form of an obtuse triangle with vertices in the point of contact between the antero- and postero-dorsal margins respectively with the anterior and posterior. They are limited by two radial lines, of which the posterior one is the more visible, which diverge symmetrically from the umbo, ending at the antero- and postero-ventral contacts.

Umbones broad, slightly protruding, straight with rounded contiguous apices. Lunule and area not visible; ornament also not visible.

Dimensions —

				sp. Bellardi
Length	mm	50 ;	46 ;	45
Height	mm	38 (76%);	38 (82%) ;	36 (80%)
Thickness	mm	23 (46%);	22.5 (48%);	—
Apical angle		130° ;	133° ;	—

Remarks — The specimens under examination exhibit considerable similarity to the illustration and description of the species given by Bellardi (1854, p. 191, pl. II, fig. 7), but are however less equilateral owing to the subventral position of the umbones, and being internal casts, are devoid of ornament.

In 1933 Cuvillier illustrated (pl. III, fig. 2, 3, 4) a specimen which differs from the ones under examination in dimensional ratios; it is smaller and proportionately lower, longer and thicker. Giannini also (1956, pl. I, fig. 19, 20) describes and illustrates specimens similar to that of Cuvillier, which furthermore lack the characteristic truncation of the anterior and posterior sides.

This subspecies is very similar to *Pterolucina pharaonis pharaonis* (Bellardi), being estranged from it only in the more transversally extended shape and in the presence of the two very developed wings; it also has some analogy with *Cavilucina thebaica* (Zittel) from which, according to some authors (Cuvillier, p. 15) it is perhaps derived.

The subspecies under examination is here assigned to the genus *Pterolucina* instituted by Chavan (1942), for the reasons already adopted in the case of the species *P. pharaonis pharaonis* (Bellardi).

Occurrence — *P. pharaonis bialata* (Bellardi) is widespread in the Middle and Upper Eocene of Egypt, of Sirtica and of Migiurtinia; in beds of probable Lower Eocene age in Cyrenaica.

Locality — Ambar Koh (61 AE-89/3); Ambar Koh (61 AE-89/4).

Family UNGULINIDAE H. & A. Adams, 1857

Genus **Diplodonta** Bronn, 1831

Diplodonta cycloidea (Bellardi, 1854)

Pl. 37, fig. 6, 7; Pl. 38, fig. 4

1854 *Lucina cycloidea* Bellardi. *Nummulitico Egitto*, p. 192, pl. III, fig. 3.
1903 *Diplodonta cycloidea* Oppenheim. *Alttertiärer Faunen Aegyptens*, p. 147, pl. XIII, fig. 4-6; pl. XVI, fig. 1, 7.

1930 *Diplodonta cycloidea* Cuvillier. *Nummulitique égyptien,* pp. 168, 270.
1933 *Diplodonta cycloidea* Cuvillier. *Contr. Nummulitique égyptien,* p. 13, pl. II, fig. 6.
1934 *Diplodonta cycloidea* Desio. *Paleog. Sirtica e Fezzan orient.,* p. 90.
1942 *Diplodonta cycloidea* Rossi. *Moll. Paleogen. Sirtica,* p. 169.
1954 *Diplodonta cycloidea* Salvan. *Invert. marocains,* p. 80.
1956 *Diplodonta cycloidea* Giannini. *Eocene Migiurtinia,* p. 31.

Three small internal casts, moderately preserved. Shell equivalve, subequilateral, discoidal, rather thick, with H/L ratio between 88% and 99%, rather convex, with maximum convexity in the medio-umbonal region, decreasing very uniformly on the respective margins. Antero- and postero-dorsal margins short, horizontal or slightly oblique, joined in a broad arc to the anterior and posterior margins, which are regularly curved and pass uniformly into the ventral margin in a broad circle.

Surface regular, crossed anteriorly and posteriorly by two radial lines, of which the posterior is the more visible, diverging from the umbo to join the antero- and postero-ventral corners and separating two regions not flattened with respect to the remainder of the surface, in the form of obtuse triangles, with the vertices in the contacts of the antero- and postero-dorsal margins respectively with the anterior and posterior. Ornament not preserved; in one of the specimens the pallial line is very clear.

Umbones small, not very prominent, positioned symmetrically, with pointed apices, not touching and in a more or less central position. Lunule and area hardly visible.

Dimensions —	Length	mm	23 ;	23 ;	21
	Height	mm	21 (91%);	20.4 (88%);	20.8 (99%)
	Thickness	mm	15 (65%);	14 (61%) ;	12 (57%)

Remarks — The specimens examined are all of lesser dimensions than those of the holotype illustrated by Bellardi (1854, pl. III, fig. 3). One of them is very similar to the latter figure in shape, while the other two largely resemble the specimen reproduced by Cuvillier (1933, pl. II, fig. 6), being of small dimensions, asymmetrical, with non-central and somewhat laterally folded umbo.

In 1906 Oppenheim illustrated symmetrical and asymmetrical casts of medium dimensions, in which there occurs very clearly a form of ornament not preserved in the Afghan samples and consisting of very numerous slender concentric lines, interspersed regularly by slightly more well-marked sulci.

The species of Bellardi is readily distinguished from several others having affinities to it, such as « *Lucina* » *scopulorum*, *ambiqua*, *saxorum*, by the absence of lateral depressions, this character and the type of ornament separating it also from « *Lucina* » *concentrica* Lamarck, which has a surface ornamented by slender projecting laminae which are less numerous than the concentric lines which ornament *D. cycloidea* (Bellardi). It shows some analogy to *Pterolucina pharaonis*, but this last has a long and well-defined lunule, which is absent in the species in question, and also has very dense concentric lines, and a less rounded general shape which is more developed lengthwise.

In « Osnovy Paleontologii », drawn up by Ebersin (1960, p. 114), the Russian authors consider the name *Taras* Risso, 1826 to have precedence by date over *Diplodonta* Bronn, 1831, a more recent synonym. Vokes whereas (1967, p. 245) considers *Taras* Risso, 1826 *nomen dubium* and holds as valid *Diplodonta* Bronn 1831.

Occurrence — *D. cycloidea* (Bellardi) has been recorded in the Eocene of Migiurtinia, of Egypt and Libya; in the Middle Eocene of Morocco.

Locality — 8 km S. of Ali Abad (61 AE-92). W. slope of Shiboglu Kotal (61 AD-58).

Suborder ASTARTEDONTINA

Superfamily CARDIACEA Lamarck, 1809

Family CARDIIDAE Lamarck, 1809

Subfamily CARDIINAE Lamarck, 1809

Genus **Cardium** Linnaeus, 1758

Cardium halaense d'Archiac, 1854

Pl. 39, fig. 1

1854 *Cardium halaense* d'Archiac. *Nummulitique Inde*, p. 257, pl. XXI, fig. 19, 20.
1903 *Cardium halaense* Oppenheim. *Alttertiärer Faunen Aegypten*, p. 154, pl. XI, fig. 13, 14.
1930 *Cardium halaense* Cuvillier. *Nummulitique égyptien*, pp. 85, 169, 271.
1931 *Cardium halaense* Cox. *Indian Eocene*, p. 83.
1951 *Trachicardium halaense* Eames. *Pakistan Eocene*, p. 409.
1952 *Cardium halaense* Tessier. *Paléont. Ouest Sénégal*, p. 344, p. XXVII, fig. 16-18.
1956 *Cardium halaense* Giannini. *Eocene Migiurtinia*, p. 33.
1962 *Cardium halaense* Elouard. *Guebla Mauritanien et Sénégal*, p. 228, pl. II, fig. 11 a-b, 12.

Two internal bivalve casts, of medium size, moderately preserved, rather thick with Th/H ratio between 64% and 70%. Shell equivalve, slightly inequilateral, subcircular in shape, slightly more high than long, with L/H ratio between 92% and 93%, regularly convex, with maximum convexity in the medio-umbonal region, decreasing rapidly towards the posterior margin, and more slowly towards the anterior and ventral margins. Antero-dorsal margin short, with indistinct course, joining the anterior margin in an arc which continues uniformly with the ventral margin. Postero-dorsal margin short, weakly convex, continuing with the long, straight and oblique posterior one, joining the curvilinear ventral one in an arc.

Surface slightly asymmetrical, very hollowed-out beneath the umbo, disappearing in the antero-ventral region; it exhibits a type of keel or line of maximum convexity in the posterior region, running from the umbo to the postero-ventral corner to define a narrow weakly concave area near the posterior margin. Umbo well defined, rather slender, almost straight, recurved forwards with apices in contact.

Ornament comprising about 30 regular radial costae, simple, slightly in relief on the surface of the valve, separated by narrow shallow sulci which are denser in the umbonal region and broaden, becoming more widely spaced, towards the ventral margin, where there originates a dentellation which is not always visible.

Dimensions —

				sp. d'Archiac
Height	mm	39 ;	39 ;	26
Length	mm	36.5 (93%);	36 (92%);	24 (92%)
Thickness	mm	27.5 (70%);	25 (64%);	18 (69%)
Apical angle		105° ;	102° ;	—

Remarks — The specimens examined are very similar to the illustration of the species given by Tessier (1952, pl. XXVII, fig. 17) in ornament and dimensional relationship; they are however less high and less thick than those illustrated in figs. 16, 18. Oppenheim (1906, pl. XI, fig. 13, 14) illustrates more symmetrical specimens, having more slender and numerous costae.

D'Archiac (1854) illustrates (pl. XXI) two specimens which differ slightly from one another in thickness and ornaments; of these, the one in fig. 19, less inflated and with broad radial costae and intervening narrow sulci, is more similar to the specimens under examination.

In conclusion, it may be said that the Afghan specimens largely resemble those of India rather than those of Senegal and of Egypt in their less trapezoidal and more swollen shape, in their dimensional relationship, as seen from the table given, and in the characteristic costae.

Occurrence — *C. halaense* d'Archiac has been recorded in the Eocene of Egypt, India, Pakistan, Migiurtinia and of Mauritania, in the Ypresian of Senegal.

Locality — 8 km S. of Ali Abad (61 AE-92). 4 km S. of Ali Abad (61 AE-90).

Cardium kanleanum Cotter, 1923

Pl. 39, fig. 2, 3

1923 *Cardium kanleanum* Cotter. *Eocene Burma*, p. 14, pl. VII, fig. 8; pl. IV, fig. 1.

Five internal bivalve casts, of medium and large dimensions, moderately preserved, massive, with Th/H ratio between 68% and 74%. Shell equivalve, inequilateral, globose, with subpentagonal shape, slightly more high than long, with L/H ratio between 93% and 95%, rather convex, with maximum convexity in the mid-umbonal region, more slowly decreasing towards the posterior margin than towards the anterior margin. Antero-dorsal margin slightly visible, short, hollowed-out beneath the umbo, continuing with the anterior one, slightly convex and passing indistinctly into the ventral one. Postero-dorsal margin short, slightly concave and sinuous, passing into the posterior which is long and blunted, strongly oblique and joined in a broad arc to the curvilinear ventral margin.

Surface asymmetrical, with two small lateral wing-like features; in the posterior region is observable a line of maximum convexity running from the umbo to the postero-ventral corner to form almost a very broad keel, which defines a steep and truncated posterior area.

Umbones broad and massive, recurved forwards, with apices almost touching. Ornament comprising about 30-40 radial costae visible only in the umbonal region and at times on the remainder of the surface; costae broad, simple, flattened, with broad intervening sulci, which near the ventral margin are of breadth about twice that of the costae themselves. These, at the margins, give rise to a characteristic dentellation.

Dimensions —

Height	mm	63 ;	62.7 ;	43 ;	41
Length	mm	59.2 (94%);	59.2 (95%);	40 (93%);	39 (95%)
Thickness	mm	45.6 (72%);	42.9 (68%);	29 (69%);	30.7 (74%)
Apical angle		115° ;	110° ;	115° ;	112°

Remarks — The Afghan specimens also resemble in external shape and in dimensional relationships the species *C. gigas* Defrance, but differ from it in the number and character of the costae. Whereas in *Cardium gigas* Defrance the number of costae is much greater than 50, and the costae are dense and slender, the present specimens are ornamented by about 40 costae, spaced and flattened, similar to those of *C. kanleanum* Cotter, which has about 48. On account of these characters it appears better to identify the specimens under study with the species of Cotter.

Occurrence — *C. kanleanum* Cotter has been recorded in the Upper Eocene of Burma.

Locality — 4 km S. of Ali Abad (61 AE-91/2). 8 km S. of Ali Abad (61 AE-92). Ambar Koh (61 AE-89/3).

Suborder VENERINA

Superfamily ARCTICACEA Newton, 1891

Family ARCTICIDAE Newton, 1891

Genus **Arctica** Schumacher, 1817
(= *Cyprina* Lamarck, 1818)

Arctica subathooensis (d'Archiac, 1854)
Pl. 39, fig. 4

1854 *Cyprina subathooensis* d'Archiac. *Nummulitique Inde*, p. 243, pl. XIX, fig. 1-10.
1952 *Cyprina subathooensis* Tessier. *Paléont. Ouest Sénégal*, p. 335, pl. XXIV, fig. 18, 19.
1966 *Cyprina subathooensis* var. *e* Ionesi. *Lamell. Lucacesti*, p. 87, pl. II, fig. 2, 3.

Four internal bivalve casts, of moderate size, moderately well preserved, rather thick, particularly in the postero-dorsal region, with thickness averaging about 18 mm. Shell equivalve, inequilateral, subquadrangular to subtriangular in shape, slightly more long than high, with maximum length in the ventral region and H/L ratio between 91 and 100%, convex in the postero-umbonal region, slowly decreasing and becoming very slender and sharp towards the anterior and ventral margins. Antero-dorsal margin hollowed out beneath the umbo, then straight and forming a tight arc at the anterior margin, passing imperceptibly into the ventral margin; postero-dorsal margin long, almost straight, continuing regularly with the convex posterior margin and joining the ventral one in a broad arc. In all of the specimens the postero-ventral corner is situated more ventrally than the antero-ventral one.

Surface asymmetrical with umbo in the anterior region at about 41% of the total length and very hollowed-out beneath the umbo. Umbones inclined forwards, well distinguished, small, rather pointed at its extremity, with slightly detached apices. Lunule very hollowed-out, broad, heart-shaped. Area elongate in the form of a narrow triangle, clearly visible in only two specimens.

Surface of internal casts very corroded and retaining no trace of the internal characters.

Dimensions —

Length	mm	39.8 ;	36 ;	35 ;	34
Height	mm	37.5 (94%);	33 (91%) ;	33 (94%) ;	34 (100%)
Thickness	mm	18.5 (49%);	18.5 (56%);	18.5 (56%);	18 (53%)
Apical angle		109° ;	105° ;	107° ;	111°

Remarks — The specimens examined are completely devoid of ornament, which according to the author of the species should consist of concentric striae.

In instituting the species, d'Archiac divided the specimens examined into various subspecies. The limited number of specimens available does not permit the subdivision to be followed by the present writer, even though a certain morphological variability is observable between the various specimens, particularly with respect to dimensional relationships.

The specimens figured and described by Tessier (1952) are much larger and higher.

Occurrence — *A. subathooensis* (d'Archiac) has been recorded in the Ypresian in India and in Senegal; in the Upper Eocene of the Moldova Valley.

Locality — 8 km S. of Ali Abad. 61 AE-92.

Arctica transversa (d'Archiac, 1854)

Pl. 40, fig. 1, 2

1854 *Cyprina transversa* d'Archiac. *Nummulitique Inde,* p. 244, pl. XVIII, fig. 9-12.
1952 *Cyprina transversa* Tessier. *Paléont. Ouest Sénégal,* p. 335, pl. XXV, fig. 1-3.
1966 *Cyprina transversa* var. *b,* Ionesi. *Lamell. Lucacesti,* p. 87, pl. II, fig. 4.

Two bivalve internal casts, well preserved, of moderate size, rather thick particularly in the postero-dorsal region, with thickness equal to about 55% of the length. Shell equivalve, inequilateral, subtriangular in shape, more long than high, with H/L ratio averaging about 80%, convex in the postero-umbonal region; very expanded towards the ventral margin. Antero-dorsal margin long, hollowed-out beneath the umbo then straight and joining the ventral margin in a somewhat restricted arc; postero-dorsal margin not very convex, long, extending for about 89% of the total height of the valve, passing imperceptibly posteriorly in a broad arc into the slightly curvilinear ventral margin.

Surface extending in the anterior region in the form of a beak, limited dorsally by the anterior muscle scar, while in the posterior region it terminates with rounded margins. Umbones situated in the anterior third of the valve, inclined forward, convex and prominent, with pointed apices. Lunule not very clear, cordiform in shape, rather broad; area very elongate occupying the whole of the postero-dorsal margin, rather narrow. Surface smooth with pallial line situated immediately beneath the median height of the valve; only the anterior muscle scar visible, oval in shape, bounded internally by a well-defined fold.

Dimensions —	Length	mm	43.9 ;	40 ;	38.5
	Height	mm	35.4 (51%);	22 (55%);	33 (85%)
	Thickness	mm	22.2 (80%);	32 (80%);	23 (59%)
	Apical angle		113° ;	114° ;	110°

Remarks — The specimens examined closely approach in dimensional relations and shape the illustration of the species given by Tessier (1952, pl. XXV, fig. 1-3) except that the thickness is less. This character finds its equivalent in the types of the species reproduced by d'Archiac. Of these the specimen most resembling the Afghan ones is that illustrated in plate XVIII, fig. 11, 11 a, which is less high and more beaked than the others and has a rather pronounced depression corresponding to the postero-ventral margin.

A. transversa (d'Archiac) has a certain affinity to *A. subathooensis* (d'Archiac), from which it is however distinguished by its more oval outline and its different dimensional ratios.

Occurrence — *A. transversa* (d'Archiac) has been recorded in the Ypresian of the India and Senegal; in the Upper Eocene of the Moldova Valley.

Locality — 8 km S. of Ali Abad (61 AE-92). Ambar Koh (61 AE-89/3).

Superfamily Corbiculacea Gray, 1847

Family Corbiculidae Gray, 1847

Genus **Corbicula** Mégerle, 1811

(= *Cyrena* Lamarck, 1818)

Corbicula veneriformis (Deshayes, 1856-1866)

Pl. 40, fig. 8

1856-1866 *Cyrena veneriformis* Deshayes. *Animaux sans vertèbres*, p. 499, pl. XXXVIII, fig. 1, 2.

1886 *Cyrena veneriformis* Cossmann. *Eocéne envir. Paris*, p. 120.

1904-1906 *Cyrena* (*Corbicula*) *veneriformis* Cossmann and Pissarro. *Eocéne Paris*, pl. XIII, fig. 57-14.

One internal bivalve cast, of moderate size, not very well preserved. Shell equivalve, inequilateral, subtriangular in shape, relatively thick, slightly more long than high, with H/L ratio averaging 94%; not very convex. Antero-dorsal margin short, hollowed out beneath the umbo, then weakly convex, continuing uninterrupted with the convex anterior margin which meets the curvilinear ventral margin in a broad arc. Postero-dorsal margin long, very oblique, weakly convex, passing into the posterior one, which joins the ventral margin in a narrow arc. The contact between the posterior and ventral margins is very low, occurring at about 85% of the total height of the valve. The surface exhibits a keel-like feature in the anterior region (or at least a line of maximum convexity), running obliquely from the umbo to the antero-ventral contact and delineating a narrow weakly concave area adjacent to the anterior margin.

Umbones rather large, well defined, rather pointed at the extremity, very folded anteriorly and situated in about the anterior quarter of the total length. Lunule hardly visible, area narrow, hollowed out, very elongate.

Dimensions —

			sp. Cossmann
Length	mm	25 ;	41
Height	mm	23.5 (94%);	37 (90%)
Thickness	mm	14 (59%) ;	—
Apical angle		72° ;	—

Remarks — The specimen under examination is deformed and flattened by external pressure. This dorsal shifting of one valve with respect to the other results in an asymmetrical positioning of the two umbones and distorts the shape of the area and of the lunule, rendering the identification more difficult.

In 1824 Deshayes considered the genus *Cyrena* (p. 117) but, like the preceding French paleontologists, did not take account of the genus *Corbicula* which had already been proposed by Mégerle in 1811 and included the latter form in the genus *Cyrena*. In 1886 Cossmann employed the name *Corbicula* Mégerle, 1811 for a subgenus of the genus *Cyrena*, noting that *Corbicula* had priority over *Cyrena*, created by Lamarck only in 1818; it was therefore to be retained for certain forms. Subsequently Russian authors in Ebersin « Osnovy Paleontologii » (1960, p. 105) kept the two above-mentioned forms separate, referring to the institution of the genus *Corbicula* made in 1811 for several forms diverging from the typical *Cyrena*, which the specimen under examination resembles. Vokes also (1967, p. 301) considers *Cyrena* Lamarck synonymous of *Corbicula* Mégerle.

Occurrence — *C. veneriformis* (Deshayes) has been recorded in the Thanetian of the Paris basin at Chalons-sur-Vesle.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Superfamily Veneracea Rafinesque, 1815

Family Veneridae Rafinesque, 1815

Subfamily Venerinae Rafinesque, 1815

Genus **Venus** Linnaeus, 1758

Venus everesti d'Archiac, 1854

Pl. 40, fig. 4-6

1854 *Venus everesti* d'Archiac. *Nummulitique Inde*, p. 250, pl. XX, fig. 3.

Three internal bivalve casts, small, rather well preserved, somewhat swollen, particularly in the umbonal region, with Th/L ratio averaging 62%. Shell equivalve, very inequilateral, lenticular in shape, subtriangular to suboval; with rounded angles, more long than high, with H/L ratio between 90% and 94%, and maximum convexity in the dorsal region, decreasing gently towards the ventral region, and more rapidly on the sides. Antero-dorsal margin short, hollowed out beneath the umbo, oblique and forming a broad arc with the anterior margin, slightly convex and passing uniformly into the ventral. Postero-dorsal margin oblique, very extended, continuing imperceptibly into the posterior one, joined in a broad arc to the ventral one, weakly curvilinear.

Umbones broad, prominent and folded towards the anterior margin, with apices not in contact with one another, situated in the anterior region at about 1/3 of the total length of the valve. Lunule cordiform, rather large and hollowed out; area rather broad and elongate.

On the surface of one specimen there appears the pallial line, parallel to the ventral margin and situated in the lower third approximately of the valve.

Dimensions —	Length mm	23 ;	19.7 ;	19
	Height mm	21 (91%);	17.8 (90%);	18 (94%)
	Thickness mm	14 (60%);	12 (60%) ;	13 (68%)
	Apical angle	109° ;	109° ;	108°

Remarks — The specimens examined coincide in dimensional relationships and shape with the specimens illustrated for the species by d'Archiac (1854, pl. XX, fig. 3); one of them in particular has height and length the same as those of the type; the thickness is however slightly less.

Occurrence — *V. everesti* d'Archiac has been recorded in the Lower Tertiary of the marls of Subathoo in India.

Locality — W. slope of Shiboglu Kotal (61 AD-58). Mountains S. of Tashkurgan (61 AD-59/3).

Venus sp. ind. aff. **matheroni** Coquand, 1862 (in Tessier, 1952)
Pl. 40, fig. 3

An internal bivalve cast, well preserved, of medium size, rather thick, with Th/L ratio uniform at 64%. Shell equivalve, inequilateral, trigonal and expanded in shape in the ventral region such that the length and height are the same; moderately convex, with maximum convexity in the umbonal region, more sharply decreasing towards the posterior margin than towards the anterior one. Antero-dorsal margin hollowed out beneath the umbo, subrectilinear, oblique, short, passing with a broad curve into the anterior margin, rather long and oblique, joined in an obtuse angle to the ventral margin. Postero-dorsal margin convex, in a regular arc, continuing gradually into the posterior one, rather long, forming an obtuse angle with the ventral one, curvilinear.

Umbones small, slightly recurved, slightly folded forwards, with apices not in contact, situated in the anterior side at about 46% of the length. Lunule small and swollen, area not very broad, elongate, distinct. Surface smooth with pallial line parallel to the ventral margin and at a distance of 21% of the total height from it, interrupted by the pallial sinus which is not very prominent.

Dimensions —	Length	mm 28
	Height	mm 28 (100%)
	Thickness	mm 18 (64%)
	Apical angle	110°

Remarks — The specimen under examination is very similar to *Venus* sp. ind. aff. *matheroni* Coquand recorded by Tessier (1952, p. 349, pl. XXVIII, fig. 13-15) in the Ypresian and Lutetian of the Senegal; it shows only some affinities with *Venus matheroni* Coquand (Coquand 1862, p. 280, pl. XXX, fig. 13-14), which is more triangular in shape and considerably bigger in size, and has a less convex posterior margin and umbones larger, more recurved and with a greater distance between them.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Venus cf. **gumberensis** d'Archiac, 1854

Pl. 40, fig. 7

cf. 1854 *Venus gumberensis* d'Archiac. *Nummulitique Inde,* p. 249, pl. XVIII, fig. 6a, 7, 8a.

One internal bivalve cast, of medium size, not very well preserved, rather thick in the umbonal region, with Th/L ratio averaging 62%. Shell equivalve, inequilateral, subtriangular in shape, elongated transversally, more long than high, with height averaging 80% of length, very convex in the postero-dorsal region, decreasing abruptly towards the posterior side, more slowly on the ventral and anterior sides. Antero-dorsal margin hollowed-out beneath the umbo, oblique, forming a broad arc with the anterior margin, well developed, convex and passing gradually into the ventral one; postero-dorsal margin rounded and convex, passing uniformly into the posterior one; ventral margin subrectilinear. Surface rather swollen in the posterior region, slightly concave in the antero-dorsal region, extending in a lobe-like development, narrow and rounded, in the anterior region.

Umbones broad, almost indistinguishable from the remainder of the surface, with pointed apices, widely spaced, prominent, folded forwards, situated in the anterior quarter of the length. Lunule large, deep, cordiform, extending for about 1/3 of the total height; area broad and very elongate along the whole of the postero-dorsal margin. Surface completely smooth, with anterior muscle scar directed from the antero-dorsal margin obliquely to the ventral margin without joining it.

Dimensions —	Length	mm	41
	Height	mm	33 (80%)
	Thickness	mm	25.5 (62%)
	Apical angle		108°

Remarks — The specimen examined is similar to the illustration of *V. gumberensis* given by d'Archiac, particularly to fig. 8 a of plate XVIII; nevertheless, on account of its imperfect state of preservation the present author has identified it with a certain amount of caution and reserve. It is in fact more extended lengthwise than the specimen depicted in fig. 6 a and has a more developed and acute anterior region; the postero-ventral corner is truncated and the thickness is greater. Fig. 7 of the same plate depicts a juvenile specimen, with only slightly pronounced umbones, a slightly hollowed out lunule and a more oval shape than the specimen under examination.

Occurrence — *V. gumberensis* d'Archiac has been recorded in the whole of the Eocene, in the black marls of Subathoo in India.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Subfamily Meretricinae Fischer, 1887

Genus **Meretrix** Lamarck, 1799
(= *Cytherea* Lamarck, 1806)

Meretrix aegyptiaca (Mayer-Eymar in litt., Oppenheim, 1906)
Pl. 41, fig. 4

1906 *Cytherea aegyptiaca* Oppenheim. *Alttertiärer Faunen Aegypten*, p. 169, pl. XVIII, fig. 4; text-fig. p. 170.
1930 *Cytherea aegyptiaca* Cuvillier. *Nummulitique égyptien*, p. 85, p. 170.
1952 *Meretrix* cf. *aegyptiaca* Tessier. *Paléont. Ouest Sénégal*, p. 348.

An internal bivalve cast, of medium size, well preserved. Shell equivalve, inequilateral, swollen, rather thick, with Th/L ratio averaging 60%, slightly more long than high with H/L ratio averaging 93%. Antero-dorsal margin oblique, short, hollowed out beneath the umbo, slightly undulate and forming a broad arc with the rounded anterior, and continuing uniformly into the curvilinear ventral one. Postero-dorsal margin straight, long, inclined, joined in an obtuse angle to the posterior, slightly curved and subvertical, passing smoothly into the ventral. Surface with less extended anterior side than posterior, with maximum convexity in the umbonal region, decreasing gently towards the margins.

Umbones not very prominent; robust with pointed apices not in contact, prosogyre, directed towards the anterior margin and situated in the anterior third of the total length. Lunule small, not readily visible, area lanceolate.

Dimensions — Length	mm	30
Height	mm	28 (93%)
Thickness	mm	18 (60%)
Apical angle		110°

Occurrence — *M. aegyptiaca* (Mayer-Eymar) has been recorded in the Lower Eocene and perhaps in the Lutetian of Egypt, and of Senegal.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Meretrix incrassata (Sowerby, 1817)
Pl. 41, fig. 3

1817 *Venus incrassata* Sowerby, (in Agassiz, 1837). *Great Britain*, p. 208, pl. 155, fig. 1, 2.
1906 *Cytherea incrassata* Oppenheim. *Alttertiärer Faunen Aegypten*, p. 173, pl. XIX, fig. 24.
1909 *Meretrix incrassata* Toniolo. *Eocene Istria*, p. 288, pl. II, fig. 7.
1922 *Cordiopsis incrassata* Newton. *Nigeria Eocene*, p. 85, pl. 9, fig. 15-17 (*cum syn*).
1942 *Meretrix incrassata* Rossi. *Moll. Paleogen. Sirtica*, p. 178, pl. X, fig. 10.
1951 *Peleciora* (*Cordiopsis*) *incrassata* Eames. *Pakistan Eocene*, p. 427.
1954 *Meretrix incrassata* Salvan. *Invert. marocains*, p. 88, pl. VII, fig. 7, 8, 13, 18.
1962 *Meretrix incrassata* Gekker, Osipova and Bel'skaya. *Paleogen. Ferghana*, p. 308, pl. XVII, fig. 4; pl. XIX, fig. 2.
1966 *Meretrix* (*Cordiopsis*) *incrassata* Ionesi. *Lamell. Lucacesti*, p. 85, pl. I, fig. 6.

An internal bivalve cast, rather badly damaged and deformed, of medium size, rather thick, with Th/H ratio averaging 66%. Shell equivalve, inequilateral, rather more high than long, with L/H ratio averaging 97%, moderately convex, with maximum convexity in the umbonal region, more rapidly decreasing towards the posterior side than towards the anterior side. Antero-dorsal margin rather short, rather hollowed out beneath the umbo, joined in an arc to the anterior margin, quite short, rounded, passing uniformly into the curvilinear ventral margin. Postero-dorsal margin somewhat extended, slightly convex and continuing smoothly into the posterior margin, arched and forming a broad arc with the ventral one.

Umbones small, acute with rather well spaced apices, not very prominent, rather folded anteriorly and directed anteriorly also. Lunule slightly spread, cordiform; area lanceolate and slightly depressed. Internal characters not preserved.

Dimensions —	Height	mm	37
	Length	mm	36 (97%)
	Thickness	mm	24.5 (66%)
	Apical angle		95°

Remarks — The sole specimen under examination is rather damaged and deformed, but presents the characteristic spherical shape and the same umbonal course shown in the illustrations of the species given by most of the authors consulted. Gekker, Osipova and Bel'skaya reproduce specimens which are less convex and more elongate; it is prudent to bear in mind that *Meretrix incrassata* (Sowerby) exhibits notable variations in shape and dimensions.

Occurrence — *M. incrassata* (Sowerby) is widespread in all the Eocene outcrops of the Mediterranean basin; in the Upper Eocene of Morocco, Egypt and Moldova Valley; in the Middle and Upper Eocene of Sirtica, Nigeria and Southern-Ferghana, in the Eocene of Pakistan, England and France. It is also present in the Oligocene of France, Italy and England.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Meretrix semisulcata (Lamarck, 1806)

Pl. 41, fig. 5, 6

1806 *Cytherea semisulcata* Lamarck. *Mém. envir. Paris*, vol. 7, p. 133, vol. 12, pl. XL, fig. 3.
1824 *Cytherea semisulcata* Deshayes. *Foss. envir. Paris*, vol. 1, p. 140, pl. XX, fig. 4, 5; pl. XXI, fig. 1, 2.
1835 *Cytherea semisulcata* Lamarck. *Animaux sans vertèbres*, p. 330.
1918 *Cytherea semisulcata* Favre. *Coll. Lamarck*, pl. XXI, fig. 97-100.

Three internal bivalve casts of medium dimensions, moderately preserved. Shell equivalve, inequilateral, triangular-oval, with Th/L ratio between 48% and 58%, more long than high, with H/L ratio between 84% and 89%, moderately convex, with maximum convexity in the umbonal region, rapidly falling away in the lateral margins, and more gently towards the ventral margin, particularly flattened. Antero-dorsal margin oblique, slightly hollowed-out beneath the umbo, passing uniformly into the anterior margin, joining the curvilinear ventral margin in a broad arc; postero-dorsal margin longer, oblique, merging gradually into the posterior one in a tighter curve of contact with the ventral margin than is the case with the anterior one.

Umbones slightly recurved anteriorly and not very prominent, with pointed apices situated in the anterior third of the length of the valve. Lunule broad, ill-defined in shape, appearing lanceolate; area rather narrow, extending for the length of the postero-dorsal margin.

In one of the specimens the anterior muscle scar is visible, ovoid in shape; in another the pallial line is visible, running rather close to the ventral margin and exhibiting a rather narrow and long siphonal inlet extending to about half the height of the valve.

Dimensions — Length	mm	38 ;	36 ;	36
Height	mm	34.1 (89%);	32 (88%);	30 (84%)
Thickness	mm	20 (52%) ;	21 (58%);	17.5 (48%)
Apical angle		114° ;	110° ;	114°

Remarks — The specimens examined correspond well to those of the Lamarck collection illustrated by Favre (1918, pl. XXI, fig. 97-100), but as internal casts not showing the ornament, which from the illustrations beneath appear to consist of dense and slender concentric growth lines.

Occurrence — *M. semisulcata* (Lamarck) has been recorded in the Lutetian of the Paris district.

Locality — 8 km S. of Ali Abad (61 AE-92). Ambar Koh (61 AE-89/3).

Meretrix transversa (Sowerby, 1823)
Pl. 41, fig. 1, 2

1823 *Venus transversa* Sowerby, (in Agassiz, 1842). *Great Britain*, p. 442, pl. 422, fig. 1, 2, 3.
1906 *Cytherea transversa* Oppenheim. *Alttertiärer Faunen Aegypten*, p. 167, pl. XVIII, fig. 6.
1930 *Meretrix transversa* Cuvillier. *Nummulitique égyptien*, pp. 170, 272.
1952 *Meretrix transversa* Tessier. *Paléont. Ouest Sénégal*, p. 347, pl. XXVIII, fig. 9-12.
1956 *Meretrix* cfr. *transversa* Giannini. *Eocene Migiurtinia*, p. 32.

Three internal bivalve casts, well preserved, of medium dimensions, rather thick, with Th/L ratio between 61% and 65%. Shell equivalve, inequilateral, subtriangular in shape, more long than high, with H/L ratio between 87% and 95%, very convex, with maximum convexity in the umbonal region, flattening towards the ventral margin more rapidly than on the lateral margins. Antero-dorsal margin short, hollowed-out beneath the umbo, joined to the anterior margin in a not particularly broad arc, slightly convex and passing uniformly into the ventral one. Postero-dorsal margin very convex, continuing indistinctly with the posterior one which forms a broad arc with the almost straight ventral margin.

Umbones small, pointed, with apices in contact, slightly folded forward, situated about 1/4 of the length of the anterior side. Lunule broad; only the cordiform shape of this is visible; area rather broad, elongate, rather deep.

Dimensions —	Length	mm	39 ;	38 ;	32
	Height	mm	37 (94%);	36 (95%);	28 (87%)
	Thickness	mm	24 (61%);	25 (65%);	21 (65%)
	Apical angle		88° ;	92° ;	84°

Remarks — The specimens under examination are very similar to those illustrated for the species by Tessier (1952, pl. XXVIII, fig. 9-12) which appear very thick, with small swollen umbones and with anterior and posterior sides rather extended but truncated; they are however slightly higher.

Sowerby (1842, pl. 422) illustrates on the other hand more longitudinally developed individuals with rounded sides and with ornament comprising numerous and regular slender concentric lines; the ornament is however not visible in the specimens under examination.

Occurrence — *M. transversa* (Sowerby) has been recorded in the Lutetian of Senegal and in the Middle and Upper Eocene of Egypt and Migiurtinia. It occurs in the Lower Eocene of England.

Locality — W. slope of Shiboglu Kotal. 61 AD-58.

Bibliography

Archiac A. (d'), Haime J., 1854 — *Description des animaux fossiles du groupe Nummulitique de l'Inde.* T. II, pp. 225-373, 21 pl., Paris.

Bellardi L., 1852 — *Catalogue raisonné des fossiles nummulitiques du Comté de Nice.* Mém. Soc. Géol. France, s. II, t. IV, pt. II, pp. 206-300, 11 pl., Paris.

Bellardi L., 1854 — *Catalogo ragionato dei fossili nummulitici d'Egitto.* Mem. R. Acc. Sc., s. 2, vol. XV, pp. 171-203, 3 pl., Torino.

Böhm J., 1899 — *Ueber einige Fossilien aus Buchara.* Zeit. Deut. Geol. Ges., Bd. 51, H. 3, pp. 465-470, 2 pl., Berlin.

Böhm J., 1903 — *Ueber cretaceische und eocäne Versteinerungen aus Ferghana.* In Futterer K.: *Durch Asien,* Bd. III, Lief. 1, pp. 95-111, 1 pl., Berlin.

Böhm J., 1933 — *Die palaeogene Fauna Ost Turkestans.* Zeit. Deut. Geol. Ges., Bd. 85, H. 2, pp. 99-118, 3 pl., Berlin.

Bornemann B. A., Buracek A. R., Vialov O. S., 1934 — *On the question of the Tertiary and Cretaceous Ostreids distribution in Central Asia.* Bull. Soc. Nat. Mosk., s. geol., vol. XII, pp. 251-261, Moskva.

Chavan A., 1937-1938 — *Essai critique de classification des Lucines.* Journ. Conchyl., vol. LXXXI (1937), pp. 133-153, 198-216, 237-282; vol. LXXXII, (1938), pp. 59-97, 105-130, 215-241, Paris.

Chavan A., 1942 — *Sur deux nouveaux groupes de Lucinidae.* C.R.S.S. Soc. Géol. France, n. 7-8, pp. 61-63, Paris.

CHIKHACHEV P. K., SOLUN V. I., 1959 — *Sea deposits of Paleogene*. Geologie USSR, t. 24, SSR Tajikistan, pp. 308-316, Moskva. (In russian).

COQUAND M. H., 1862 — *Géologie et Paléontologie de la région sud de la Province de Constantine*. Mém. Soc. Emulation Provence, t. II, pp. 5-341, 35 pl., Marseille.

COSSMANN M., 1886-1896 — *Catalogues illustré des Coquilles Fossiles de l'Eocène des environs de Paris, faisant suite aux travaux paléontologiques de G.P. Deshayes*. Ann. Soc. R. Malacol. Belgique, s. I, t. 21, 174 pp., 8 pl.; t. 22, 215 pp., 8 pl.; t. 23, 328 pp., 12 pl.; t. 24, 385 pp., 12 pl.; t. 26, 166 pp., 3 pl.; t. 28, 16 pp.; t. 31, 94 pp., 3 pl., Bruxelles.

COSSMANN M., PISSARRO G., 1904-1906 — *Iconographie complète des coquilles fossiles de l'Eocène des environs de Paris*. T. 1, Pélécypodes, 45 pl., Paris.

COTTER P., 1923 — *The Lamellibranchiata of the Eocene of Burma*. Palaeont. Indica, n.s., vol. VII, mem. n. 2, 26 pp., 7 pl., Calcutta.

COX L. R., 1931 — *A contribution to the Molluscan Fauna of the Laki and basal Khirthar Groups of the Indian Eocene*. Trans. R. Soc. Edinburgh, vol. LVII, pt. I, pp. 25-92, 1 pl., Edinburgh.

COX L. R., 1938 — *Fossiles éocènes du Nord-Afghanistan*. In de CIZANCOURT M., COX L. R.: *Contribution à l'étude des faunes tertiaires de l'Afghanistan*, pt. II. Mém. Soc. Géol. France, n.s., v. 17, mém. n. 39, pp. 24-44, 2 pl., Paris.

COX L. R., 1960 — *Thoughts on the classification of the Bivalvia*. Proc. Malac. Soc., v. 34, pt. 2, pp. 60-88, 2 fig., London.

CUVILLIER J., 1930 — *Révision du Nummulitique égyptien*. Mém. Inst. Egypte, t. 16, 371 pp., 25 pl., Le Caire.

CUVILLIER J., 1933 — *Nouvelle contribution à la paléontologie du Nummulitique Egyptien*. Mém. Inst. Egypte, t. 22, 76 pp., 8 pl., Le Caire.

DESHAYES G. P., 1824-1837 — *Description des coquilles fossiles des environs de Paris*. 2 T., (392 + 814) pp., (65 + 101) pl., Paris.

DESHAYES G. P., 1856-1866 — *Description des animaux sans vertèbres decouverts dans le bassin de Paris*, 3 T., 1832 pp., 194 pl., Paris.

DESIO A., 1934 — *Lamellibranchi paleogenici della Sirtica e del Fezzan orientale*. Missione Scient. Cufra, vol. III, pp. 85-130, 8 pl., Roma.

DESIO A., 1960 — *Ricognizioni geologiche nell'Afghanistan*. Boll. Soc. Geol. Ital., vol. LXXXIX, fasc. 3, pp. 99-179, 19 fig., Roma.

DESIO A., MARTINA E., PASQUARÈ G., 1964 — *On the geology of central Badakhshan*. Quart. Journ. Geol. Soc., vol. 120, pp. 127-151, 3 fig., London.

DI STEFANO G., 1920 — *Osservazioni sul Cretaceo e sull'Eocene del Deserto Arabico e di El-Sibaiya nella valle del Nilo*. Boll. R. Com. Geol. Italia, vol. XLVII, fasc. 1-4, 39 pp., 11 pl., Roma.

DONCIEUX L., 1911 — *Catalogue descriptif des fossiles nummulitiques de l'Aude et de l'Hérault*. Pt. 2, fasc. 2, *Corbières septentrionales*. Ann. Univ. Lyon, n.s., fasc. 30, 199 pp., 16 pl., 21 fig., Lyon.

DOUVILLÉ H., 1910 — *Observations sur les Ostréides. Origine et classification*. Bull. Soc. Géol. France, s. 4, t. X, pp. 634-646, 2 pl., Paris.

EBERSIN A. G., 1960 — *Fundamentals of Palaeontology* (Osnovy Paleontologii). Vol. 3: *Molluscs-Amphineura, Pelecypods and Scaphopoda*. Ak. Nauk USSR, 300 pp., 44 pl., 280 fig., Moskva.

EAMES F. E., 1951 — *A contribution to the study of the Eocene in Western Pakistan and Western India. B. The description of the Lamellibranchia from standard sections in* *the Rakli Nala and Zinda Pir areas of the Western Punjab and Kohat District*. Phil. Trans. R. Soc., s. B, n. 627, v. 235, pp. 311-482, 9 pl., London.

Elouard P., 1962 — *Etude géologique et hydrogéologique des formations sédimentaires du Guebla mauritanien et de la vallée du Sénégal*. Pt. III, Paléontologie. Mém. B.R. G.M., n. 7, pp. 209-271, 8 pl., Paris.

Favre J., 1918 — *Catalogue illustré de la collection Lamarck*. Mus. Hist. Nat. Génève, pt. I, 117 pl., Génève.

Freneix S., Gorodiski A., 1963 — *Bivalves Eocènes du Sénégal*. Pt. I. Mém. B.R.M.G., n. 17, 123 pp., 13 pl., Paris.

Gekker R. F., Osipova A. I., Bel'skaya T. N., 1962 — *Ferghana Gulf of Paleogenic Sea of Central Asia. Its history, sediments, fauna and flora, their environment and evolution*. 2 vol. Ak. Nauk USSR, Paleont. Inst., vol. I, 335 pp., 22 pl., 89 fig.; vol. II, 332 pp., 27 pl., 70 fig., Moskva. (In russian).

Giannini E., 1956 — *Molluschi eocenici della Migiurtinia*. Palaeont. Ital., t. 32, suppl. 7, pp. 23-45, 3 pl., Pisa.

Gorizdro S. F., 1913 — *Material for the tertiary Turkestan fauna study*. Tr. SPB, Ob.est., v. XXXVII, n. 5, sect. geol. min., 57 pp., 2 pl., Petersburg.

Gorodiski A., 1950 — *Etudes sur les Ostréidés du Nummulitique du Sénégal*. Bull. Soc. Géol. France, s. 5, t. XX, pp. 353-375, 2 pl., Paris.

Hinze C., 1964 — *Die geologische Entwicklung der östlichen Hindukush-Nordflanke* (*Nordost-Afghanistan*). Beih. Geol. Jahrb., H. 70, pp. 19-75, 2 pl., Hannover.

Kaever M., 1963 — *Das Hadjar-Kreide Tertiär - Profil und seine Stellung in der Ober-Kreide Zentral-Afghanistan*. N. Jh. Geol. Paläont., pp. 669-677, Stuttgart.

Kaever M., 1967 — *Das Tertiär Afghanistans*. Zentralbl. Geol. Paläont. Teil 1, H. 2, Jahr. 1967, pp. 351-368, Stuttgart.

Kieh Yang, 1930 — *Observation sur le genre Ostrea dans l'Eocène des régions mésogéennes*. Bull. Soc. Géol. France, s. 4, t. XXX, pp. 77-100, 2 pl., Paris.

Ionesi L., Ionesi B., 1966 — *Asupra prezentei unei faune de Lamellibranchiate in Gresia de Lucacesti*. An. Univ. Bucuresti, s. st. nat., an. XV, n. 2, pp. 81-96, 5 pl., Bucuresti.

Lamarck J. B., 1806, 1808 — *Mémoires sur les fossiles des environs de Paris*. Ann. Mus. Hist. Nat., t. 7 (1806), pp. 130-140; t. 12 (1808), pp. 456-459, 4 pl., Paris.

Lamarck J. B., 1835 — *Histoire naturelle des animaux sans vertèbres*. T. VI, 600 pp., Paris.

Leymerie A., 1881 — *Description géologique et paléontologique des Pyrénées de la Haute Garonne*. pp. XVII + 1010, 20 pl., Toulouse.

Locard A., 1889 — *Description des Mollusques fossiles des terrains inférieurs de la Tunisie récueillis en* 1885-1886 *par M. Ph. Thomas*. Expl. Scient. Tunisie, fasc. 1, 65 pp., 5 pl., Paris.

Marwick J., 1960 — *Early tertiary Mollusca from Otajo gorge South Canterbury*. N. Zealand Geol. Surv., Paleont. Bull., n. 33, 31 pp., 11 pl., Wellington.

Mirkamalov K. K., 1964 — *The systematic position of Amphidonta*. Paleont. Zhurn., n. 2, pp. 149-152, 1 pl., Moskva. (Transl. Intern. Geol. Rev. 1965, vol. 7, n. 9, pp. 1687-1690, 1 pl., Washington).

Morozova V. G., Kreidenkov G. P., Davidson R. M., 1965 — *Biostratigraphy of the Paleocene deposits in the Tajikistan Depression*. BMOIP, Geol. Ser., vol. 40, n. 3, pp. 34-56, Moskva. (In russian).

NEWTON R. B., 1905 — *The tertiary Fossils of Somaliland as represented in the British Museum (Natural Hystory)*. Quart. Journ. Geol. Soc., vol. 61, pp. 155-180, 5 pl., London.

NEWTON R. B., 1922 — *Eocene Mollusca from Nigeria*. Geol. Surv. Nigeria Bull., n. 3, 148 pp., 12 pl., London.

OPPENHEIM P., 1903-1906 — *Zur Kenntnis alttertiärer Faunen in Aegypten*. Palaeontographica, Bd. 30, Abth. III, Lief. I (1903), pp. 1-164, 17 pl.; Lief. II (1906), pp. 165-348, 10 pl., Stuttgart.

OSIPOVA A. I., 1958 — *Polemical questions concerning Lower Paleogene Stratigraphy in Southeastern Central Asia*. Izv. Ak. Nauk USSR, s. Geol., 1958, n. 8, Moskva. (Transl. AGI, 1960, pp. 75-89, Washington).

PAVAY A., 1871 — *Kolozsvar Környékének földtani viszonyai*. - A Magyar hiralyi földtani intézet evkönyveö.

PETRUSHEVSKIY B. A., 1937 — *La découverte de la faune paléocène en Tajikistan*. Dokl. Ak. Nauk USSR, n.s., vol. XIV, 81 pp., Leningrad.

PIVETEAU J., 1952 — *Traité de Paléontologie*. T. II. Lamellibranches, Ed. Masson, pp. 220-364, Paris.

POPOL S. A., TROMP S. W., 1954 — *The stratigraphy and main structural features of Afghanistan*. K. Nederl. Ak. Wetens., s. B., vol. 57, n. 3, pp. 370-394, 3 pl., Amsterdam.

ROMANOVSKIY G., 1878 — *Geologische und paläontologische Uebersicht des nordwestlich Thian-Schan und des südöstlichen Theiles der Niederung von Turan*. Material. Geol. Turkestan, Lief. I, pp. VIII + 167, 30 pl., St. Petersburg.

ROMANOVSKIY G., 1882 — *The Ferghanian stage of Cretaceous series and their paleontological characters*. Sap. SPB Mineral Obsh., s. 2, n. 17, pp. 35-60, 8 pl., St. Petersburg. (In russian).

ROMANOVSKIY G., 1884 — *Historische Geologie: Paläontologischer charakter der Sedimentärbildungen des westlichen Thian-Schan und der Turanischen Niederung*. Material. Geol. Turkestan, Lief. II, pp. XII + 159, 28 pl., St. Petersburg.

ROSSI C., 1942 — *Molluschi paleogenici della Sirtica*. Ann. Mus. Libico St. Nat., vol. III, pp. 109-193, 4 pl., Tripoli.

SALVAN H., 1954 — *Les invertébrés fossiles des phosphates marocains*. T. II. *Paléontologie*. Notes et Mém. Serv. Géol. Maroc., n. 93, 257 pp., 18 pl., 82 fig., Paris.

SOKOLOW D. W., 1910 — *La question de l'étage Ferghanien*. Bull. Soc. Imp. Natur. Moscou, n.s., vol. XXIII, a. 1909, pp. 44-93, 8 fig., Moskva.

SOWERBY J., 1812-1846 — *The Grossbrittaniens Mineral-Conchologie. (Deutsche Bearbeitung durchgesehen berichtig unbevorwortet, d'Agassiz* 1837-1842). Vol. I, pp. (VIII + 338), 300 pl.; vol. II, pp. 339-689, 309 pl., Neuchâtel.

STEFANINI G., 1921 — *Fossili Terziari della Cirenaica*. Palaeont. Ital., vol. XXVII, pp. 101-146, 3 pl., Pisa.

STENZEL H. B., 1947 — *Nomenclatural Synopsis of supraspecies groups of the family Ostreidae (Pelecypoda Mollusca)*. Journ. Paleont., vol. XXI, n. 2, pp. 165-185, Tulsa.

TAVANI G., 1946 — *Fossili eocenici della Cirenaica*. Atti Soc. Toscana Sc. Nat., vol. LIII, pp. 172-187, Pisa.

TESSIER F., 1952 — *Contribution à la stratigraphie et à la paléontologie de la partie ouest du Sénégal (Crétacé et Tertiaire)*. Fac. Sci. Marseille (Univ. d'Aix-Marseille). I thèse, pt. II, n. 47, pp. 281-466, 26 pl., Marseille.

THOMAS P., 1893 — *Description de quelques fossiles nouveaux ou critiques des terrains tertiaires et sécondaires de la Tunisie récueillis en* 1885-1886. Explor. Scient. Tunisie, fasc. II, 46 pp., Paris.

TONIOLO R., 1909 — *L'Eocene dei dintorni di Rozzo in Istria e la sua fauna*. Palaeont. Ital., vol. XV, pp. 237-295, 3 pl., Pisa.

VIALOV O. S., 1934 — *Sur le Paléogène inférieur du Boukhara*. Dokl. Ak. Nauk USSR, n.s., vol. I, pp. 54-58, Leningrad.

VIALOV O. S., 1935 — *Subdivision schema for the Tertiary deposits of Ferghana*. Dokl. Ak. Nauk USSR, n.s., vol. II, n. 3-4, pp. 278-281, Leningrad. (In russian).

VIALOV O. S., 1936 — *Sur la classification des Huitres*. Dokl. Ak. Nauk USSR, n.s., vol. IV, n. 1, pp. 17-20, Leningrad.

VIALOV O. S., 1937a — *Sur la classification des Ostreidae et leur valeur stratigraphique*. Intern. Congr. Zool. Lisbonne, pp. 1627-1638, Lisbona.

VIALOV O. S., 1937b — *Typical Ostreids from Ferghana Palaeogene*. Tr. Geol. Rasv. Sluzhby Tresta-Sredazneft, vol. I, 48 pp. 33 pl., Tashkent. (In russian).

VIALOV O. S., 1938 — *On the Middle-Asiatic Fatina Vialov and Turkostrea Vialov*. Izv. Ak. Nauk USSR, pp. 15-18, Moskva. (In russian with english summary).

VIALOV O. S., 1948 — *Palaeogenic Ostreids from Tajik Depression*. Tr. VNIGRI, n.s., vol. 38, 94 pp., 38 pl., Leningrad-Moskva. (In russian).

VIALOV O. S., NEDELKU I., NIZA P., 1966 — *A few data on the Northern Afghanistan Palaeogene*. Geol. Sbornik Lvovsk. Geol. Obshch., n. 10, pp. 142-157, Lvov.

VOKES H., 1967 — *Genera of the Bivalvia: A systematic and bibliographic catalogue*. Bull. Amer. Paleont., vol. 51, n. 232, pp. 111-394, New York.

WOOD S. V., 1861-1871 — *A Monograph of the Eocene Bivalves of England*. Vol. I, 128 pp., 25 pl., Palaeont. Soc., London.

ZITTEL K., 1883 — *Beiträge zur Geologie und Paläontologie der Libyschen Wüste und der angrenzenden Gebiete von Aegypten*. Palaeontographica, Bd. XXX, pp. 100-102, Stuttgart.

PLATES

PLATE I

Fig. 1. - *Fasciculopyllum multiseptatum* sp. n. . . . . p. 4
Transverse section, neanic stage (at a, b interseptal « skeletal-trough »). A65-A1503 (Holotype); TS 1. × 4.

» 2. - *Fasciculophyllum multiseptatum* sp. n.
Transverse section, neanic stage. A65-A1503; TS 2. × 4.

» 3. - *Fasciculophyllum multiseptatum* sp. n.
Transverse section, neanic stage. A65-A1503; TS 3. × 4.

» 4. - *Fasciculophyllum multiseptatum* sp. n.
Transverse section, early ephebic stage. A65-A1503; TS 4. × 4.

» 5. - *Fasciculophyllum multiseptatum* sp. n.
Transverse section, ephebic stage. A65-A1503; TS 5. × 4.

» 6. - *Fasciculophyllum multiseptatum* sp. n.
Transverse section, calyx. A65-A1503; TS 6. × 4.

» 7. - *Fasciculophyllum multiseptatum* sp. n.
Exterior view. A65-A1503. × 1,8.

» 8. - *Zaphrentites* sp. p. 7
Transverse section, late neanic stage. A65-V6/12; TS 1. × 5.

» 9. - *Zaphrentites* sp.
Transverse section, base of calyx. A65-V6/12; TS 2. × 5.

» 10. - *Zaphrentites* sp.
Upper part of calyx, weathered. A65-V6/12. × 1,8.

» 11. - *Zaphrentites* sp.
Upper part of calyx, weathered. A65-V6/13. × 1,8.

» 12. - *Caninophyllum tomiense* (Tolmačev, 1931) . . . . p. 10
Transverse section, neanic stage. A65-V6/14; TS 1. × 2,5.

» 13. - *Caninophyllum tomiense* (Tolmačev, 1931)
Transverse section, neanic stage. A65-V6/14; TS 2. × 2,5.


1
a
b
2
3
C
4
C
5
7
C
6
8
9
C
C
11
10
12
13

PLATE 2

Fig. 1. - *Caninophyllum tomiense* (Tolmačev, 1931) . . . . p. 10
Transverse section, ephebic stage. A65-V6/14; TS 3. × 2,5.

» 2. - *Caninophyllum tomiense* (Tolmačev, 1931).
Transverse section, calyx. A65-V6/14; TS 4. × 2,5

» 3. - *Caninophyllum tomiense* (Tolmačev, 1931).
Transverse section, calyx. A65-V6/14; TS 5. × 2,5.

» 4. - *Caninophyllum tomiense* (Tolmačev, 1931).
Longitudinal section. A65-V6/14; LS 1. × 3,5.

» 5. - *Caninophyllum tomiense* (Tolmačev, 1931).
Transverse section, neanic stage (at a, b interseptal « skeletal-trough»). A65 V6/15; TS 1. × 2,5.

» 6. - *Caninophyllum tomiense* (Tolmačev, 1931).
Transverse section, calyx. A65-V6/15; TS 2. × 2,5.

» 7. - *Caninophyllum tomiense* (Tolmačev, 1931).
Longitudinal section through calyx region. A65-V6/15; LS 1. × 2,5.

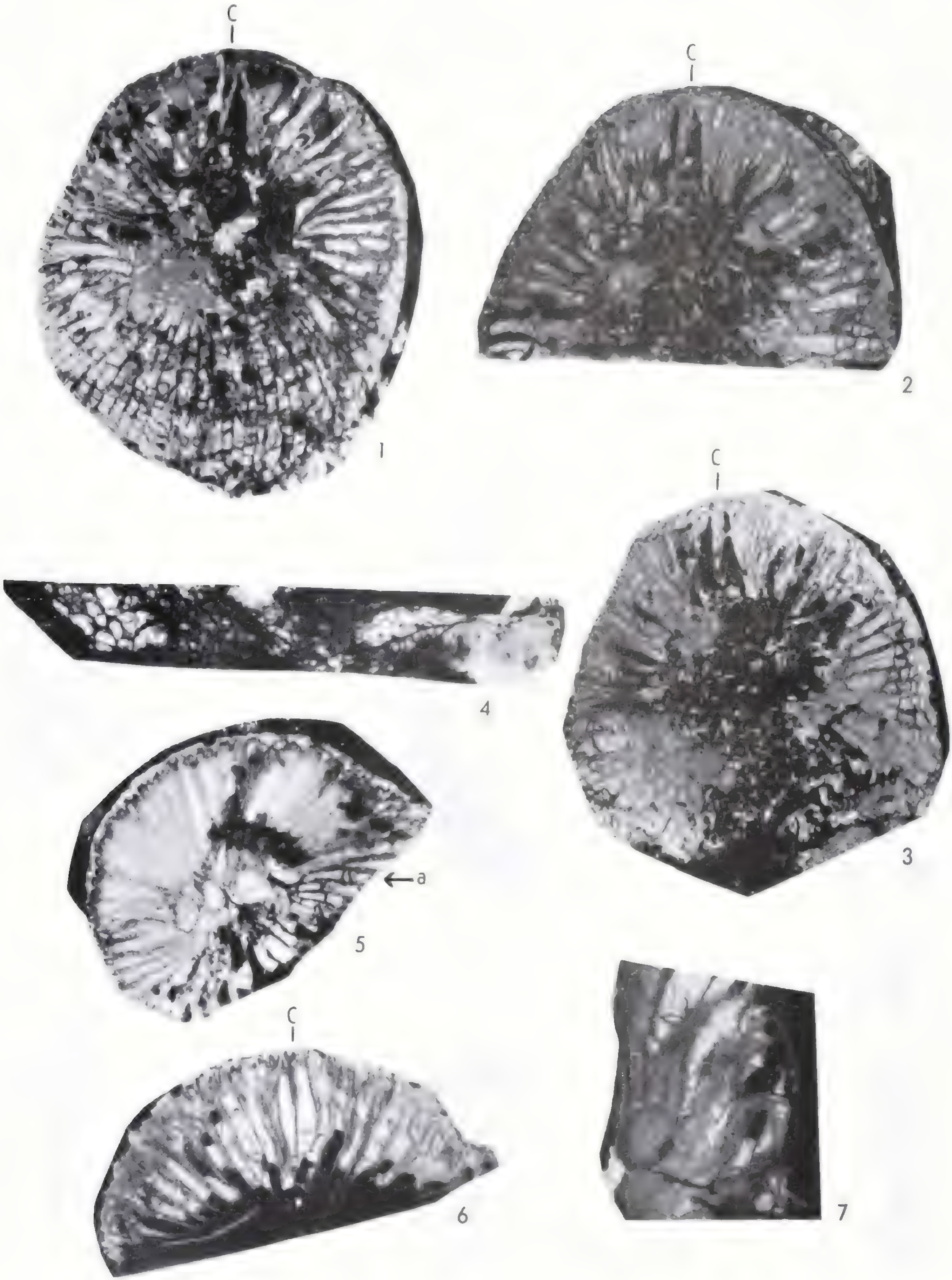

C
1
C
2
C
3
4
← a
5
C
6
7

PLATE 3

Fig. 1. - *Amygdalophyllum ? kalawchense* sp. n. . . . . p. 16
Transverse section, late neanic stage. A65-A1504 (Holotype); TS 1. × 4.

» 2. - *Amygdalophyllum ? kalawchense* sp. n.
Transverse section, ephebic stage. A65-A1504; TS 2. × 4.

» 3. - *Amygdalophyllum ? kalawchense* sp. n.
Transverse section, ephebic stage. A65-A1504; TS 3. × 4.

» 4. - *Amygdalophyllum ? kalawchense* sp. n.
Transverse section, calyx. A65-A1504; TS 4. × 4.

» 5. - *Amygdalophyllum ? kalawchense* sp. n.
Transverse section, ephebic stage. A65-A1505; TS 1. × 4,5.

» 6. - *Michelinia ?* sp. . . . . p. 18
Transverse section. A65-V6/16; TS 1. × 4,5.

» 7. - *Michelinia ?* sp.
Longitudinal section. A65-V6/16; LS 1. × 4,5.

» 8. - *Michelinia ?* sp.
Longitudinal section. A65-V6/16; LS 2. × 4,5.


C
C
C
C
1
2
3
4
5
6
7
8

PLATE 4

Fig. 1. - *Pterophyllum filicoides* (Schlotheim). Large specimen from the Kalawch river (« *P. longifolium* » form); no. 1. × 1. . . . . p. 28

» 2. - *Pterophyllum kalawchense* Barnard. Holotype no. 9 a + b. × ½. . . . . p. 35

1

2

PLATE 5

Fig. 1. - *Taeniopteris pseudobrevis* Barnard. Holotype showing corrugated and incised lamina; no. 7. × 1. . . . . p. 37

» 2. - *Pterophyllum filicoides* (Schlotheim). Narrow specimen with short broad pinnae; no. 2. × 1. . . . . p. 28

» 3. - *Otozamites ashtarense* Barnard. no. 6. × 1. . . . . p. 36

» 4. - *Pterophyllum filicoides* (Schlotheim) and second fragment of *T. pseudobrevis* Barnard. no. 5. ×1. . . . . p. 28

1

2

3

4

PLATE 6

Burmirhynchia hsenwiensis Buckman, 1918 (p. 49)

Fig. 1a-e. - Specimen F. Karkar. Ventral, dorsal, lateral, frontal and apical views. × 1
» 2a-e. - Specimen D. Karkar. Ventral, dorsal, lateral, frontal and apical views. × 1.
» 3a-d. - Specimen E. Karkar. Ventral, dorsal, lateral and apical views. × 1.
» 4a-e. - Specimen C. Karkar. Ventral, dorsal, lateral, frontal and apical views. × 1.
» 5a e. - Specimen A. Karkar. Ventral, dorsal, lateral, frontal and apical views. × 1.

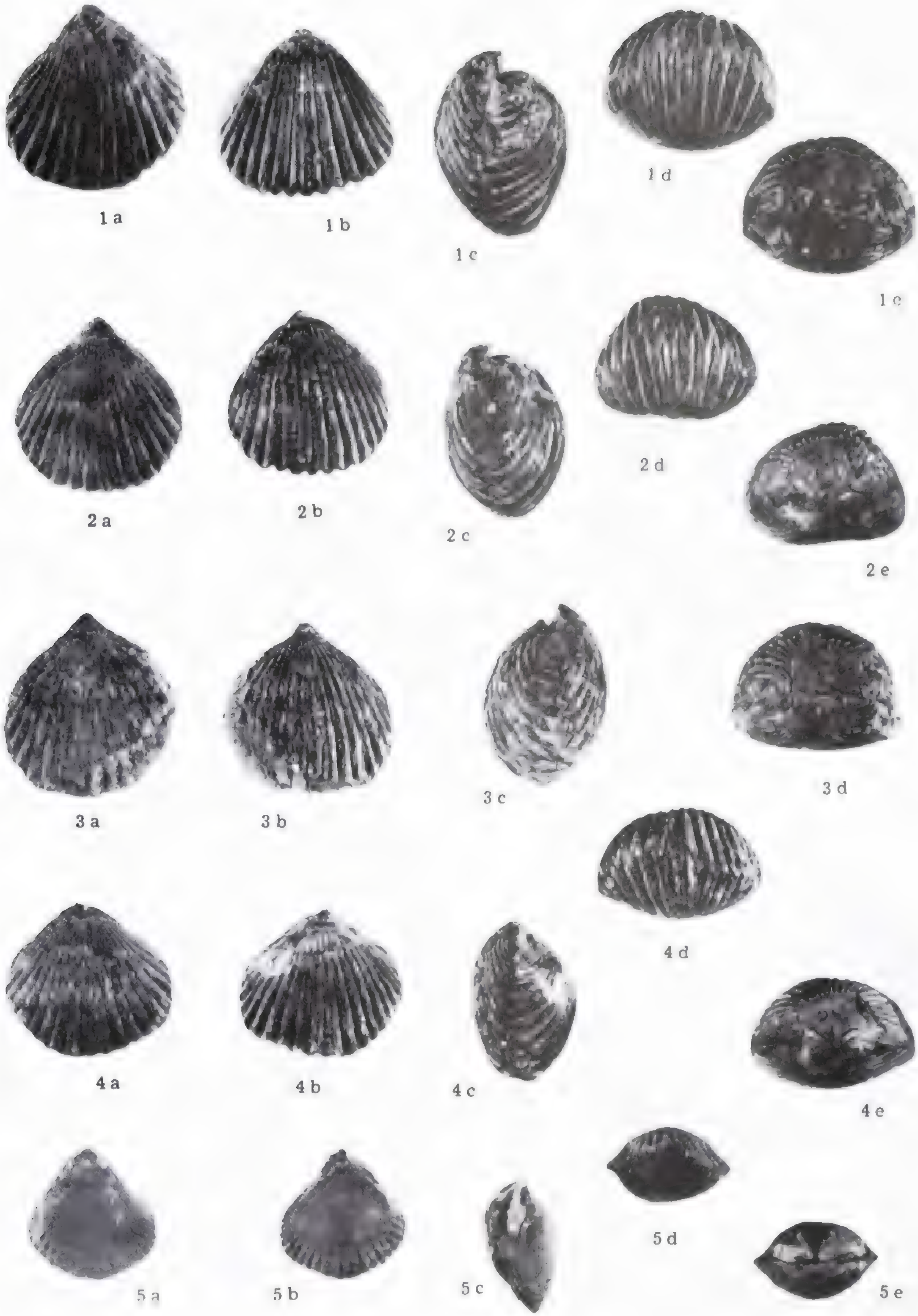

1 a
1 b
1 c
1 d
1 e
2 a
2 b
2 c
2 d
2 e
3 a
3 b
3 c
3 d
4 a
4 b
4 c
4 d
4 e
5 a
5 b
5 c
5 d
5 e

PLATE 7

Fig. 1a-b. - *Burmirhynchia hsenwiensis* Buckman. Karkar. Dorsal muscle field and del thyrium. Respectively × 4 and × 10 . . . . p. 49

» 2. - *Liostrea eduliformis* (Schlotheim). Karkar. Interior of the left valve. × 1. p. 59

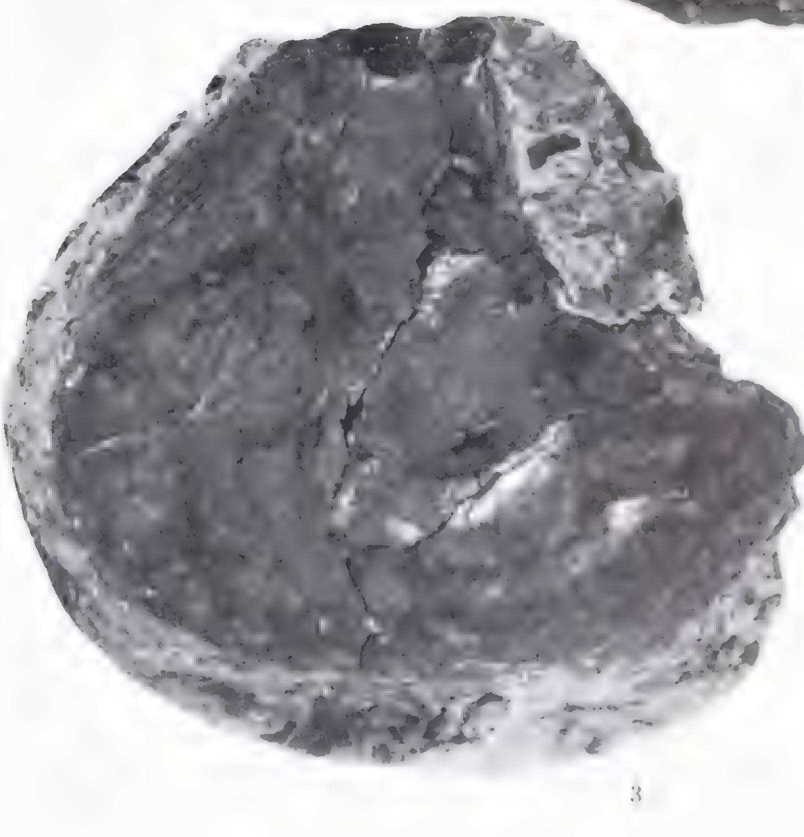
» 3. - *Liostrea eduliformis* (Schlotheim). Karkar. Interior of the right valve. × 1.

» 4. - *Liostrea eduliformis* (Schlotheim). Karkar. Interior of the left valve. × 1.

1 a

1 b

2



3

4

PLATE 8

Liostrea eduliformis (Schlotheim) (p. 59)

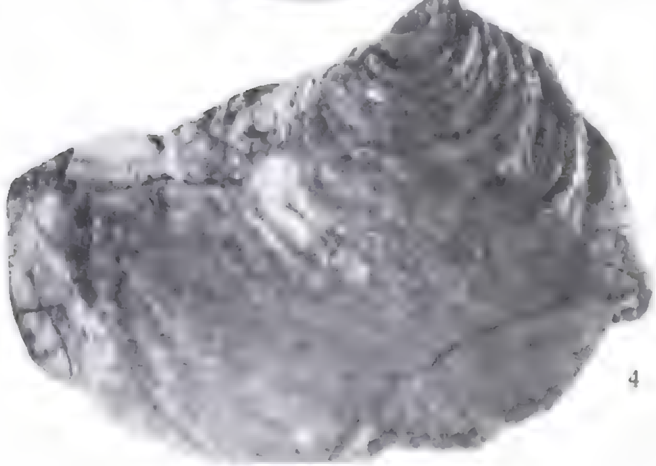
Fig. 1. - Exterior of the left valve. Karkar. × 1.
» 2a-b. - Exterior and interior of the right valve. Karkar. × 1
» 3. - Exterior of the left valve. Karkar. × 1.
» 4. - Exterior of the right valve. Karkar. × 1.

1

2 a

3

2 b



4

PLATE 9

Fig. 1a-b. - *Pronoella karkarensis* sp. n. Karkar mine. Holotype. Left valve. Respectively × 3 and × 6. . . . . p. 64

» 2. - *Pronoella karkarensis* sp. n. Karkar mine. Paratype n. 5. × 2,5.

» 3. - *Pronoella karkarensis* sp. n. Karkar mine. Paratype n. 8. × 2,5.

» 4a-b. - *Pronoella desioi* sp. n. Karkar mine. Holotype. Right valve. Respectively × 1,5 and × 3. . . . . p. 62

» 5. - *Pronoella desioi* sp. n. Karkar mine. Paratype n. 3. × 2,5.

» 6. - *Pronoella desioi* sp. n. Karkar mine. Paratype n. 4. × 2,5.

» 7. - *Pronoella desioi* sp. n. Karkar mine. Paratype n. 6. × 3.

» 8. - *Pronoella desioi* sp. n. Karkar mine. Paratype n. 2. × 2,5.

» 9. - *Ctenostreon rugosum* (W. Smith). Karkar mine. Right valve. × 1. . p. 58

» 10. - *Camptonectes richei* Dechaseaux. Karkar. Left valve. × 1. . . . p. 55

» 11. - *Eomiodon gardeti* Mongin. Karkar mine. Left valve. × 3. . . . p. 65

» 12. - *Meleagrinella echinata* (W. Smith). Karkar mine. Left valve in a coquina of *Pronoella*. × 1. . . . . p. 55


1 b
1 a
3
2
5
4 a
4 b
6
7
8
9
10
11
12

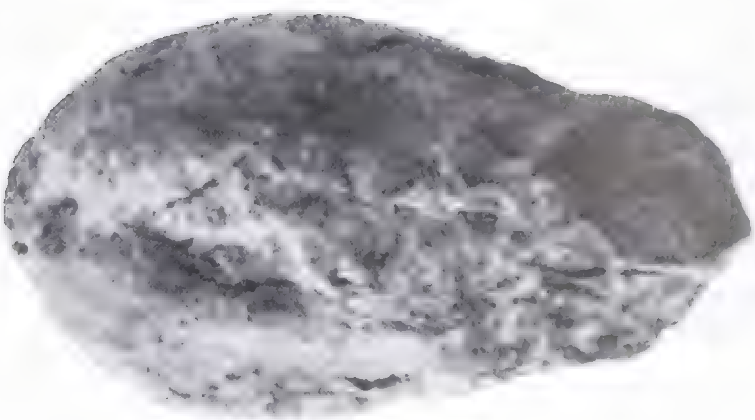
PLATE 10

Fig. 1a-b. - *Pholadomya* sp. aff. *deltoidea* (Sowerby). Karkar mine. Internal bivalve mould. Exterior and anterior views. × 1. . . . . p. 67

» 2a-c. - *Homomya douvillei* nom. n. Karkar mine. Internal bivalve mould. Dorsal, exterior and anterior views. × 1. . . . . p. 66

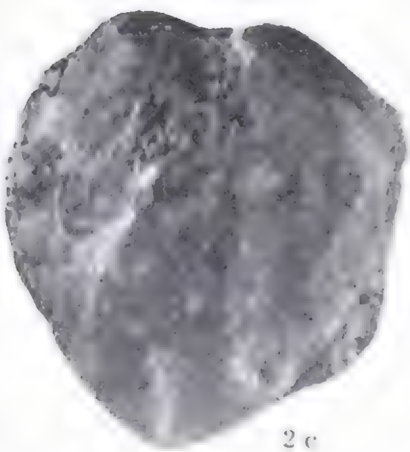
1 a

1 b



2 a

2 b



2 c

PLATE 11

Fig. 1a-b. - *Colostracon* (*Ovactaeonina*) *phasianoides* (Lycett). Karkar. Oral and aboral views. × 30. . . . . p. 71

» 2a-b. - *Cossmannea* (*Eunerinea*) *pasquarei* sp. n. Karkar. Paratype n. 2 and axial section. × 1. . . . . p. 69

» 3a-c. - *Cossmannea* (*Eunerinea*) *pasquarei* sp. n. Karkar. Paratype n. 1 and axial sections. Respectively × 1 and × 2.

» 4. - *Cossmannea* (*Eunerinea*) *pasquarei* sp. n. Karkar. Holotype × 1.

» 5a-b. - *Cossmannea* (*Eunerinea*) *pasquarei* sp. n. Karkar. Paratype n. 3 and axial section. × 1.

» 6a-c. - *Homomya douvillei* nom. n. Karkar mine. Internal bivalve mould. Exterior, dorsal and anterior views. × 1. . . . . p. 66


1 a
2 a
2 b
1 b
3 b
4
5 b
3 a
5 a
6 a
6 c
6 b
3 c

PLATE 12

Fig. 1. - *Trigonarca* sp. ind. Baba Darves. Left valve. × 1. . . . . p. 91
» 2. - *Pinna arata* Forbes. Baba Darves. Left valve. × 1. . . . . p. 91
» 3. - *Lima* (*Acesta*) cf. *obsoleta* Dujardin. Mohammad Aba. Left valve. × 1. p. 96
» 4. - *Lima canalifera* Goldfuss. Baba Darves. Left valve. × 1. . . . . . p. 95
» 5. - *Neithea* (*Neitheops*) *quinquecostata* (Sowerby). Baba Darves. Left valve. × 1. . . . . p. 93
» 6. - *Neithea gibbosa* (Pulteney). Baba Darves. Left valve. × 1. . . . . . p. 93
» 7. - *Pecten* sp. ind. Baba Darves. Right valve. × 1. . . . . p. 94
» 8. - *Amphidonte columba* (Lamarck). Road Junction of Farkhar. Exterior of the left valve. × 1. . . . . p. 97
» 9. - *Exogyra* sp. ind. Baba Darves. Left valve. × 1. . . . . p. 102


1
3
2
4
5
8
9
7
6

PLATE 13

Fig. 1a-b. - *Amphidonte columba* (Lamarck). Farkhar. Exterior and interior of the left valve. × 1. . . . . p. 97

» 2a-b. - *Amphidonte columba* (Lamarck). Farkhar. Exterior and interior of the left valve. × 1.

» 3. - *Amphidonte conica* (Sowerby). Mohammad Aba. Exterior of the left valve. × 1. p. 98

» 4. - *Amphidonte conica* (Sowerby). Mohammad Aba. Exterior of the left valve. × 1.

» 5. - *Amphidonte decussata* (Goldfuss). Baba Darves. Exterior of the left valve. × 1. p. 99

» 6. - *Ceratostroeon spinosum* (Matheron). Aq Bulaq. Exterior of the left valve × 1. p. 100

» 7. - *Ceratostreon spinosum* (Matheron). Aq Bulaq. Side of the left valve. × 1.

» 8. - *Exogyra overwegi* von Buch. Baba Darves. Side of the left valve. × 1. p. 101

» 9. - *Exogyra overwegi* von Buch. Baba Darves. Exterior of the left valve. × 1.


1 a
1 b
4
5
3
7
6
8
9
2 a
2 b

PLATE 14

Fig. 1. - *Pycnodonte vesicularis* (Lamarck). Mohammad Aba. Exterior of the left valve. × 1. . . . . p. 103

» 2. - *Pycnodonte vesicularis* (Lamarck). Mohammad Aba. Exterior of the left valve. × 1.

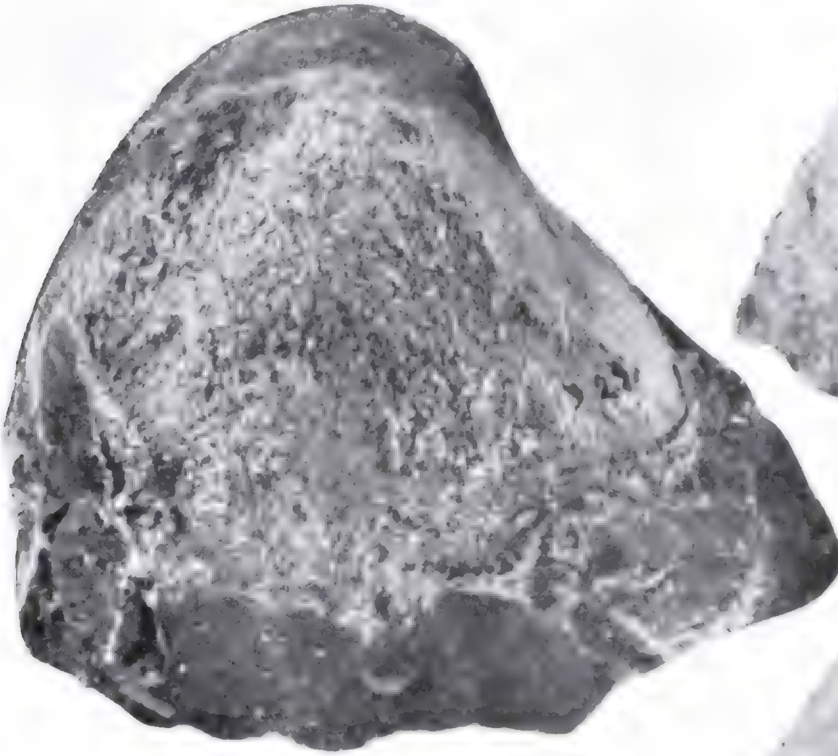
» 3a-b. - *Pycnodonte vesicularis* (Lamarck). Darra Sarkhao and Doshi. Exterior and interior of the left valve. × 1.

» 4. - *Pycnodonte vesicularis* (Lamarck). Mohammad Aba. Exterior of the left valve. × 1.

» 5a-b. - *Pycnodonte vesiculosa* (Sowerby). Darra Sarkhao and Doshi. Exterior and interior of the left valve. × 1. . . . . p. 105

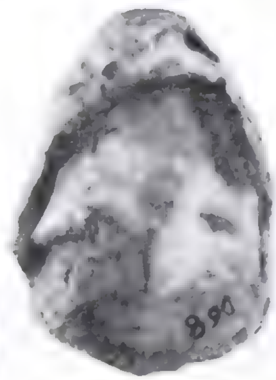
» 6. - *Pycnodonte vesiculosa* (Sowerby). Darra Sarkhao and Doshi. Exterior of the left valve. × 1.

» 7a-b. - *Pycnodonte vesiculosa* (Sowerby). Darra Sarkhao and Doshi. Exterior and interior of the left valve. × 1.



1

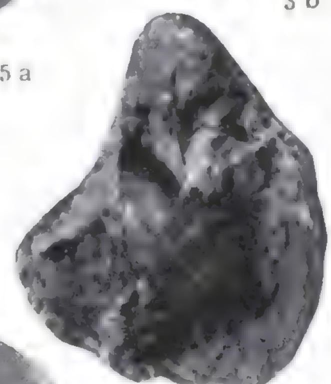
2



3 b

5 a

3 a

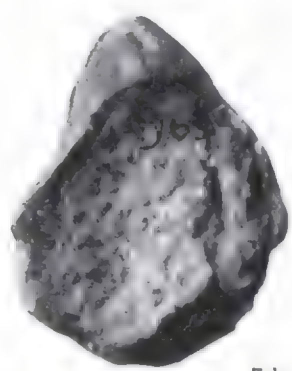


5 b

6

4

7 a



7 b

PLATE 15

Fig. 1. - *Ichthyosarcolites triangularis* Desmarest. Baba Darves. Left valve. × 1. p. 107

» 2a-b. - *Sauvagesia sanfilippoi* Parona. Mohammad Aba. Respectively exterior view and transverse section of left valve. × 1. . . . . p. 106

» 3. - *Arctica calabra* (Seguenza) Baba Darves. Right valve. × 1. . . . . p. 109

» 4. - *Arctica* sp. ind. Aq Bulaq. Left valve. × 1. . . . . p. 110

» 5. - *Cardita nicaisei* Coquand. Darra Sarkhao and Doshi. Left valve. × 1. p. 108

» 6. - *Aphrodina plana* (Sowerby). Mohammad Aba. Left valve. × 1. . . . p. 111

» 7. - *Aphrodina* cf. *plana* (Sowerby). Baba Darves. Right valve. × 1. . . . p. 111

» 8. - *Veniella* sp. ind. Darra Sarkhao and Doshi. Posterior view of internal bivalve mould. × 1. p. 111

» 9. - *Haustator multiplicatus* Pcelincev. Mohammad Aba. Aboral view. × 2. p. 113

» 10. - *Haustator multiplicatus* Pcelincev. Mohammad Aba. Aboral view. × 2. p. 113

» 11. - *Trochactaeon matensis* (Fittipaldi). Mohammad Aba. × 1. . . . . p. 113

» 12. - *Pleurotomaria* sp. ind. Mohammad Aba. Apical view. × 1. . . . . p. 112

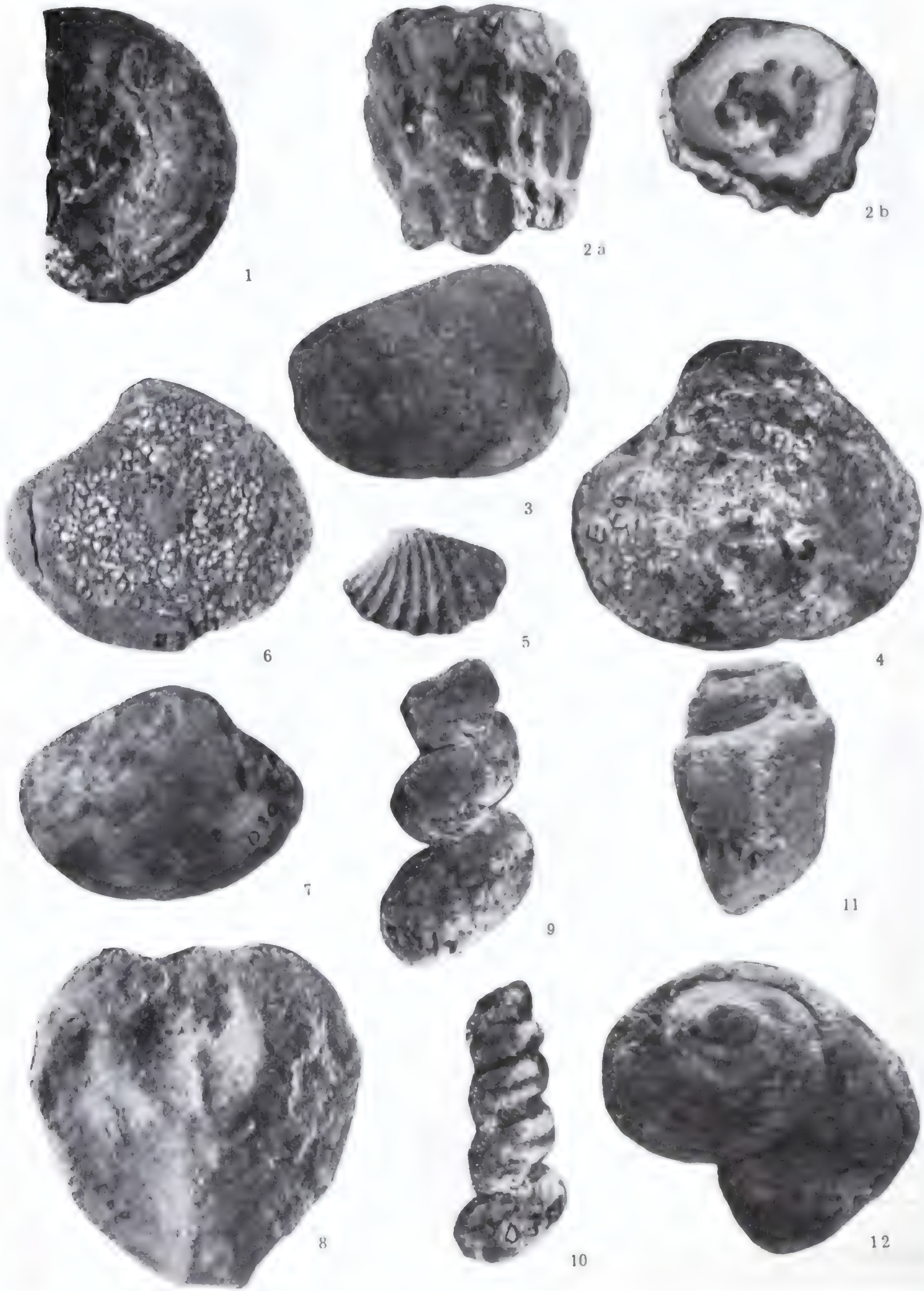

1
2 a
2 b
3
4
5
6
7
8
9
10
11
12

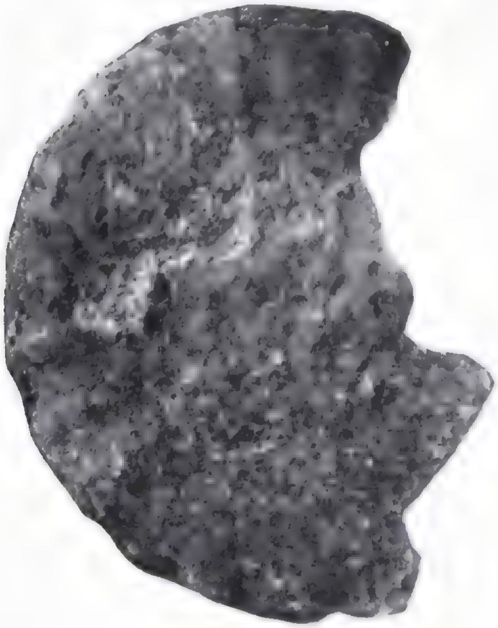
PLATE 16

Fig. 1a-c. - *Thomasites* sp. ind. Farkhar. Lateral and ventral views. × 1. . . . p. 114

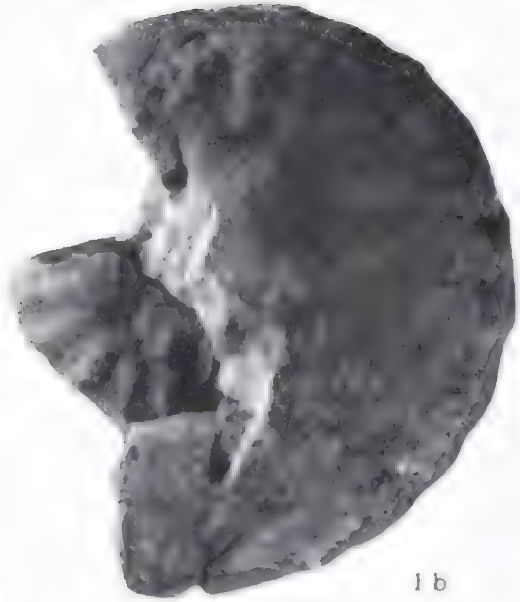
» 2a-b. - *Rectithyris odiumensis* Sahni. Baba Darves. Respectively ventral and side views. × 1. . . . . p. 87

» 3. - *Rectithyris* cf. *rotunda* Sahni. Baba Darves. Dorsal view. × 1. . . . p. 88

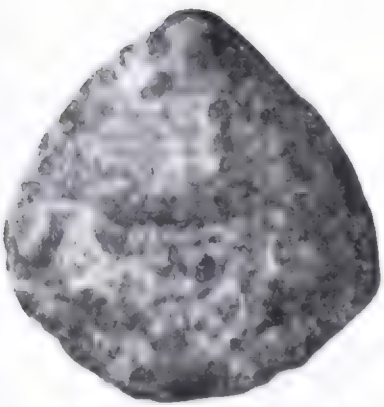
» 4a-c. - *Rectithyris subdepressa* (Stoliczka). Baba Darves. Respectively ventral, side and dorsal views. × 1. p. 89



1 a

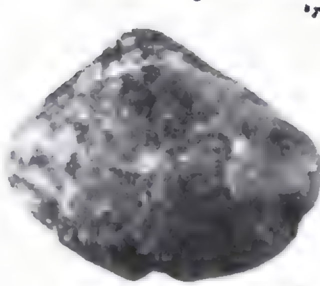


1 b



2 a

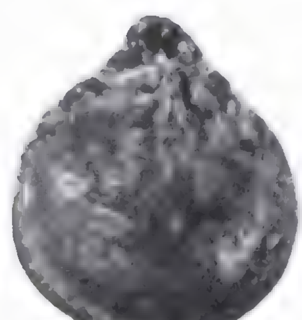
2 b



3

4 a

4 b



4 c

PLATE 17

Fig. 1-2. - *Haplophragmoides* cf. *greigi* (Henson). Karkhar section, lev. 61 AE-87/13. Cenomanian-Turonian. Axial and subaxial sections. × 65 and 60 . . . . p. 123

» 3-6. - *Pseudotextulariella* sp. Mohammad Aba outcrop, S. 61 AD-34/1. Cenomanian-Turonian. Fig. 3-5: axial sections; fig. 6: transversal section. × 110. . p. 123

» 7. - *Cuneolina* sp. Farkhar section, lev. 61 AE-87/12. Cenomanian-Turonian. Oblique section. × 68.

» 8-9. - *Cuneolina pavonia parva* Henson. Farkhar section, lev. 61 AE-87/12. Cenomanian-Turonian. Axial sections. × 68 and 90. . . . . p. 126

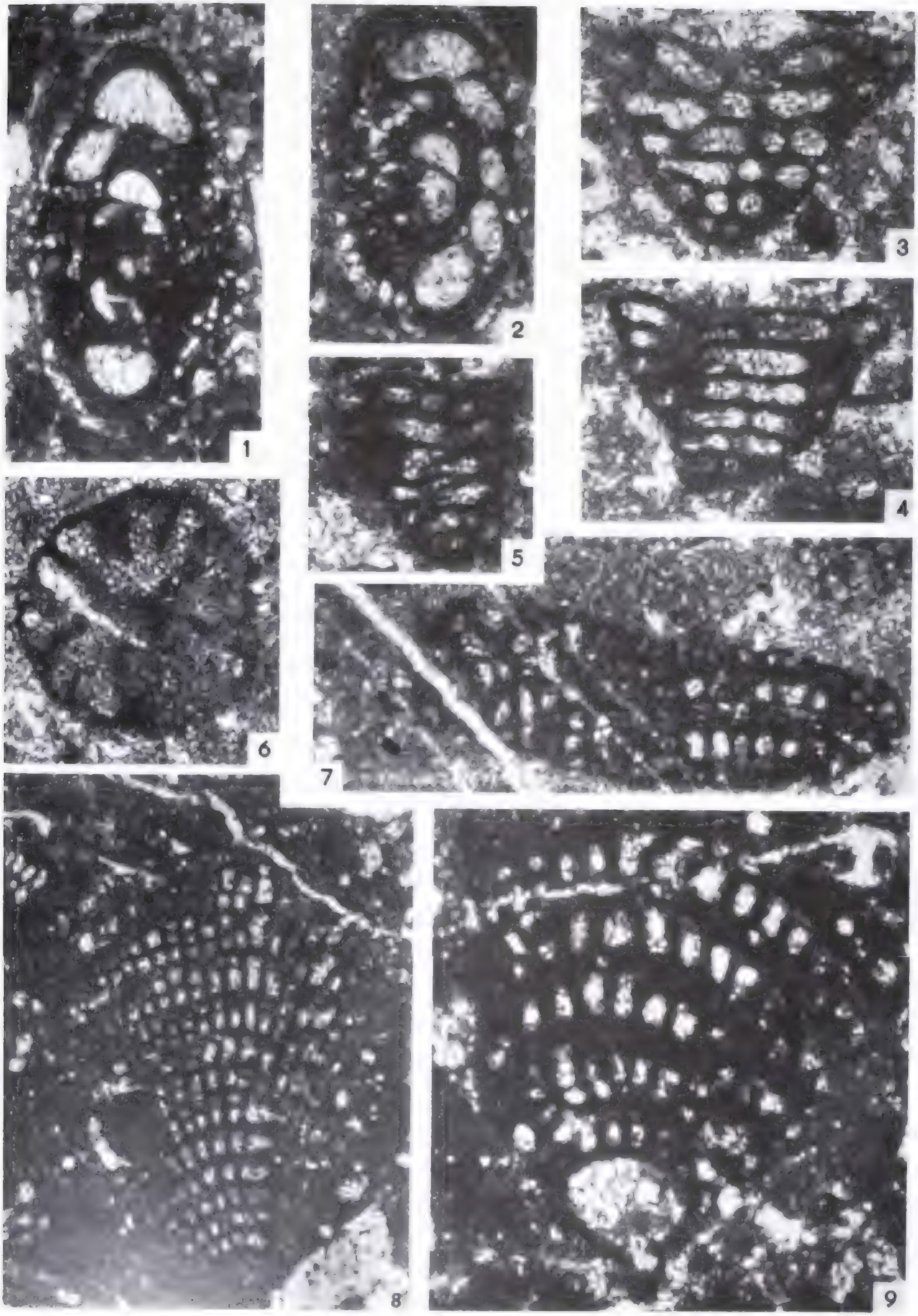

1
2
3
4
5
6
7
8
9

PLATE 18

Fig. 1,4. - *Dicyclina schlumbergeri* Munier-Chalmas. Farkhar section, lev. 61 AE-87/12. Cenomanian-Turonian. Fig. 1: axial section, × 45; fig. 4: transversal section, × 50. p. 127

» 2. - *Cuneolina pavonia parva* Henson. Farkhar section, lev. 61 AE-87/12. Cenomanian-Turonian. Subaxial section. × 21. . . . . p. 126

» 3. - *Dicyclina* cf. *schlumbergeri* Munier-Chalmas. Farkhar section, lev. 61 AE-87/12. Cenomanian-Turonian. Transversal section. × 55. . . . . p. 127

» 5. - *Cuneolina* sp. Farkhar section, lev. 61 AE-87/12. Cenomanian-Turonian. Transversal section along radius. × 50.

» 6-7. - *Orbitoides media* (d'Archiac). Baba Darves section, lev. 61 AD-30. Campanian-Maastrichtian ? Sections of embryonic apparatus. × 105. . . . . . p. 146

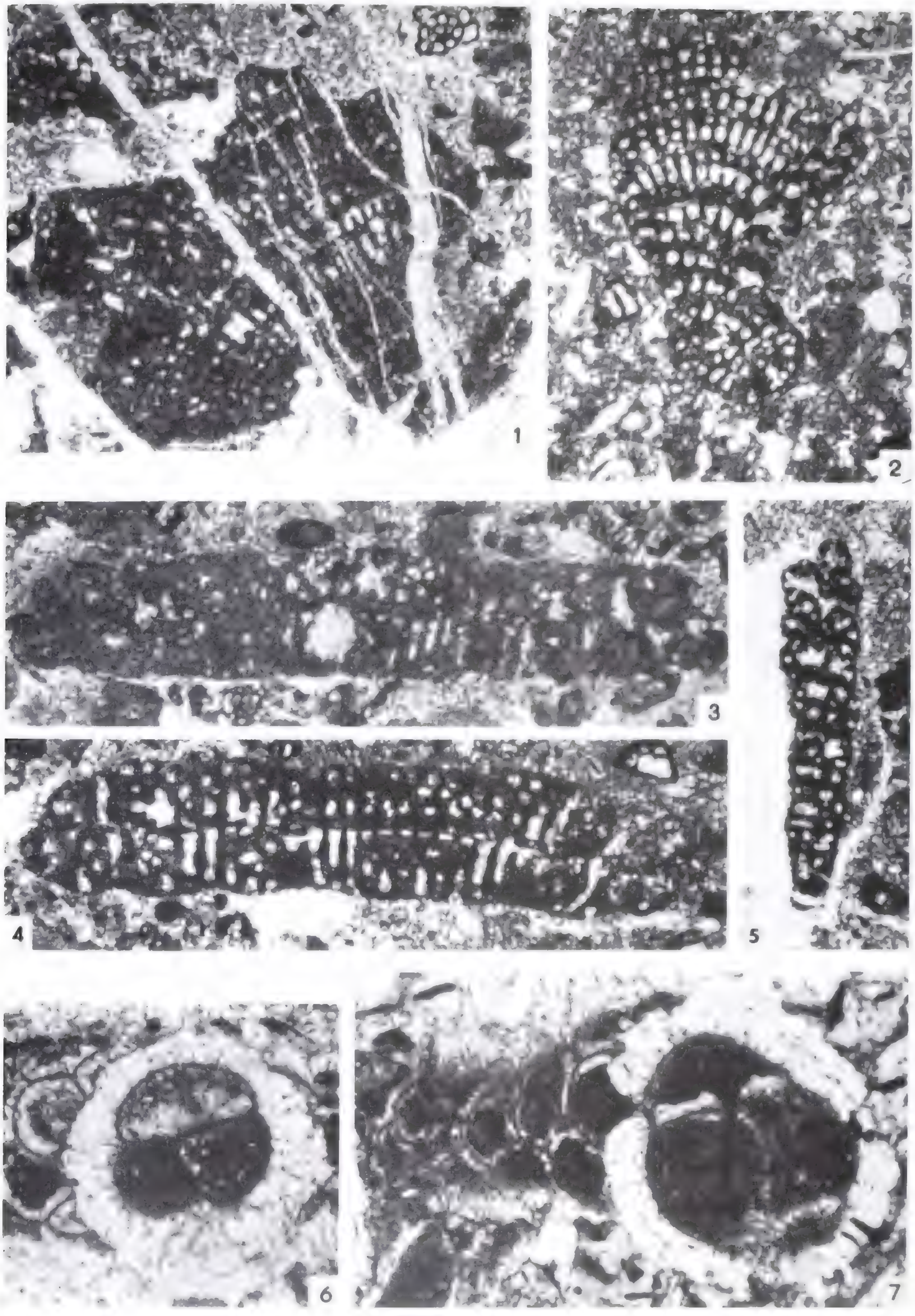

1
2
3
4
5
6
7

PLATE 19

Fig. 1. - *Orbitoides media* (d'Archiac). Baba Darves section, lev. 61 AD 30. Campanian-Maastrichtian ? Axial section. × 50. . . . . p. 146

» 2-4, 6-7. - *Orbitocyclina minima* (Douvillé). North-west of Baba Darves, S. 61 AD-35/1. Maastrichtian. Axial sections; fig. 2, 4, 7: × 35; fig. 3: × 23; fig. 6: × 45 p. 147

» 5. - *Orbitocyclina minima* (Douvillé). Baba Darves section, lev. 61 AD-30/3.. Maastrichtian. Equatorial section. × 55. . . . . p. 147

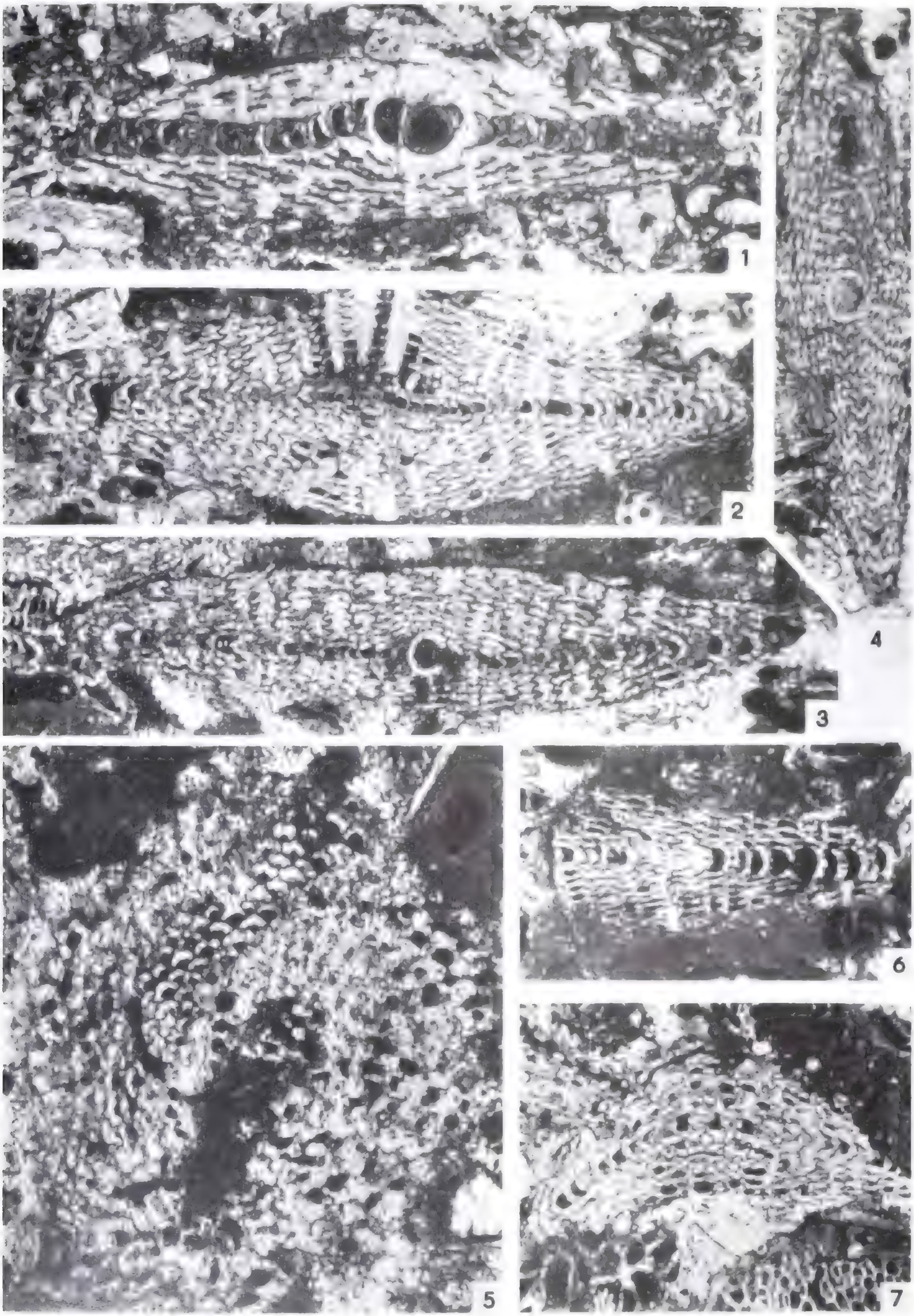

1
2
3
4
5
6
7

PLATE 20

Fig. 1-6. - *Siderolites calcitrapoides* Lamarck. Tashkurgan section, lev. 61 AD-59/12. Maastrichtian. Fig. 1-3, 5: × 40; fig. 4, 6: × 25. . . . . p. 134

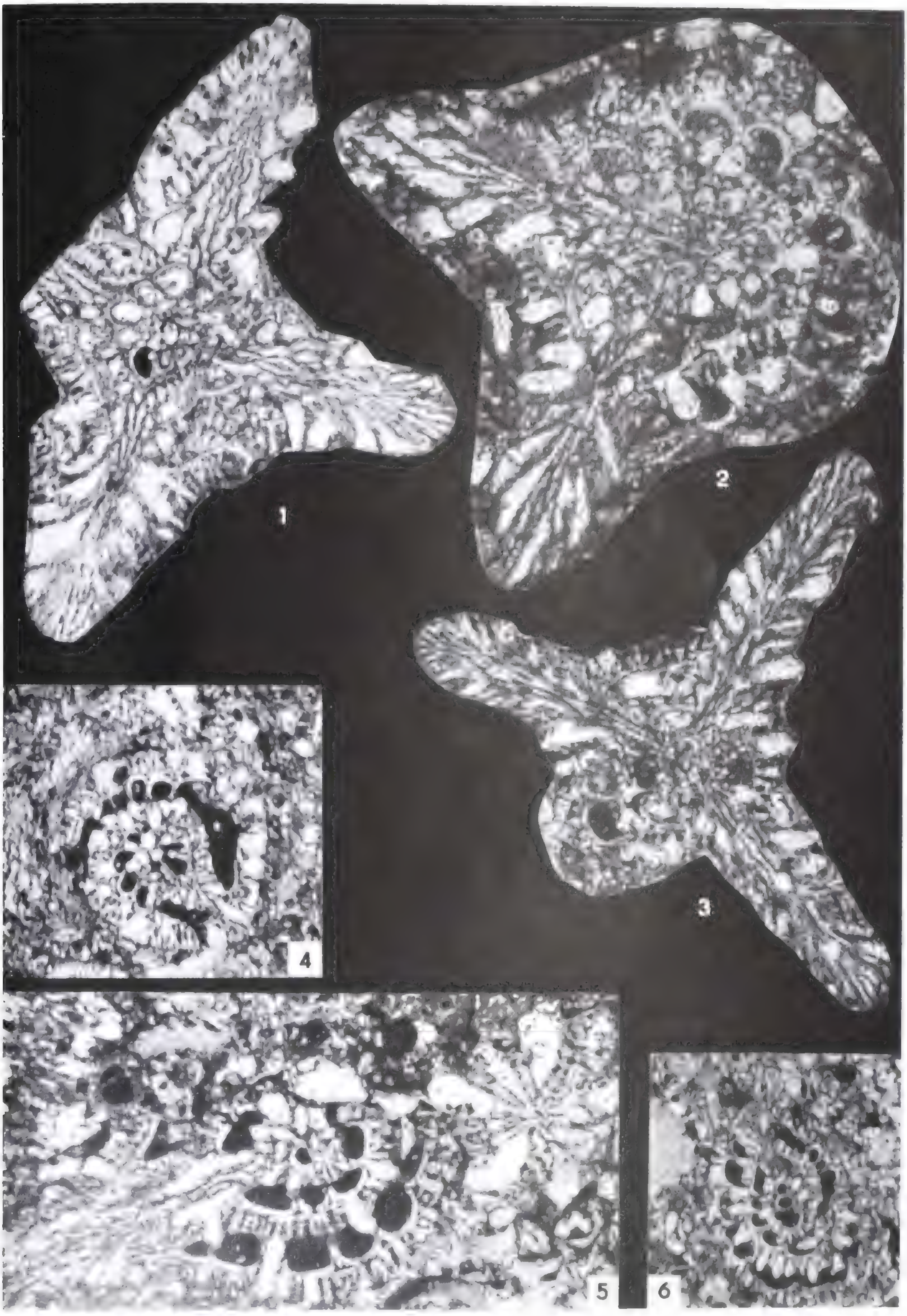

1
2
3
4
5
6

PLATE 21

Fig. 1-2. - *Vulvulina* sp. Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. Side views. × 70. . . . . p. 125

» 3. - *Virgulina* (?) *dibollensis* Cushman & Applin. Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. × 145. . . . . p. 150

» 4,8. - *Angulogerina wilcoxensis* (Cushman & Ponton). Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. × 145. . . . . p. 132

» 5. - *Gaudryina* sp. Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. × 80. p. 125

» 6-7. - *Uvigerina elongata* Cole. Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. Two views of same specimen. × 145. . . . . p. 130

» 9a-c. - *Gyroidinoides scrobiculata* (Cushman & Ponton). Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. × 85. . . . . p. 153

» 10a-c. - *Gyroidina* aff. *angustiumbilicata* Ten Dam. Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. × 85. . . . . p. 152

» 11a-b. - *Cibicides succedens* Brotzen. Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. × 60. . . . . p. 146

» 12a-c. - *Anomalina toddae* Harris & Jobe. Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. × 85. . . . . p. 154

a = spiral view
b = umbilical view
c = side view

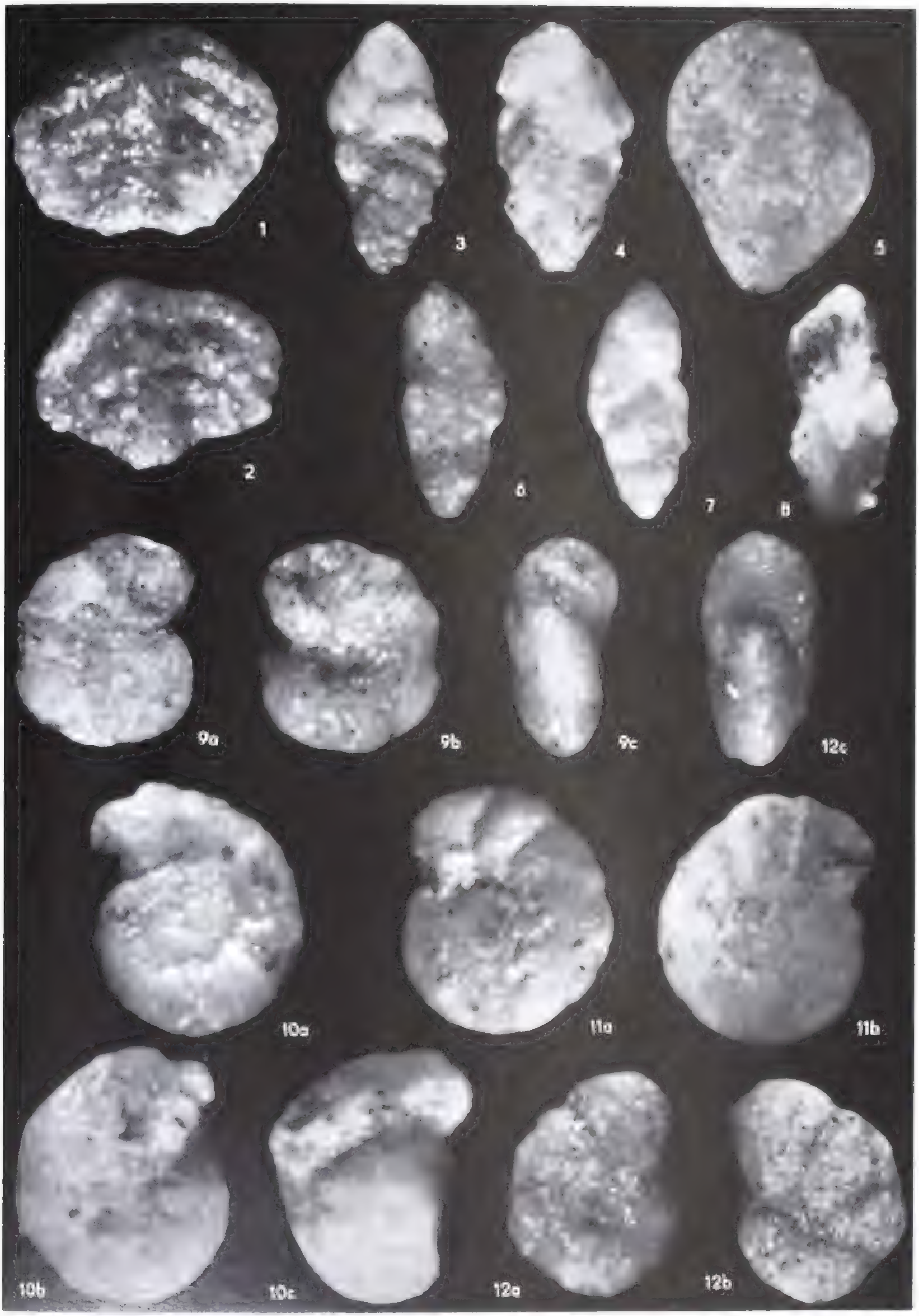

1
3
4
5
2
6
7
8
9a
9b
9c
12c
10a
11a
11b
10b
10c
12a
12b

PLATE 22

Fig. 1. - *Dentalina communis* (d'Orbigny). Ambar Koh section, lev. 61 AE-89/2. Middle Paleocene. × 90. p. 129

» 2-3. - *Nodosaria bacillum minor* Hantken. Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. × 75. . . . . p. 128

» 4. - *Nodosaria bacillum* Defrance. Ali Abad section, lev. 61 AE-91/3. Middle-Upper Paleocene. × 50. p. 127

» 5-7. - *Marginulina longiforma* (Plummer). Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. Fig. 6: microsphaeric form. Fig. 5-6, × 55; fig. 7, × 45. p. 129

» 8a-10b. - *Karreria fallax* Rzehak. Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. Fig. 8a-b and 10a-b, × 55; fig. 9a-b, × 90. . . . . p. 155

a = spiral view
b = umbilical view


1
2
4
5
3
6
7
10a
9a
8a
8b
9b
10b

PLATE 23

Fig. 1a-c. - *Allomorphina conica* Cushman & Todd. Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. . . . . p 151

» 2. - *Uvigerina spinicostata* Cushman & Jarvis. Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. p. 131

» 3a-c, 5a-c. - *Valvulineria iphigenia* Samoilova. Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. p. 132

» 4a-c. - *Gyroidinoides soldanii octocamerata* (Cushman & Hanna). Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. . . . . p. 153

» 6a-c. - *Pararotalia heckeri* (Bykova). Tashkurgan section, lev. 61 AD-59/6. Lower Eocene. p. 134

» 7a-b. - *Spiroplectammina monetalis* Bykova. Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. a: side view; b: edge view. . . . . p. 124

a = spiral view
b = umbilical view
c = side view
All figures × 110.

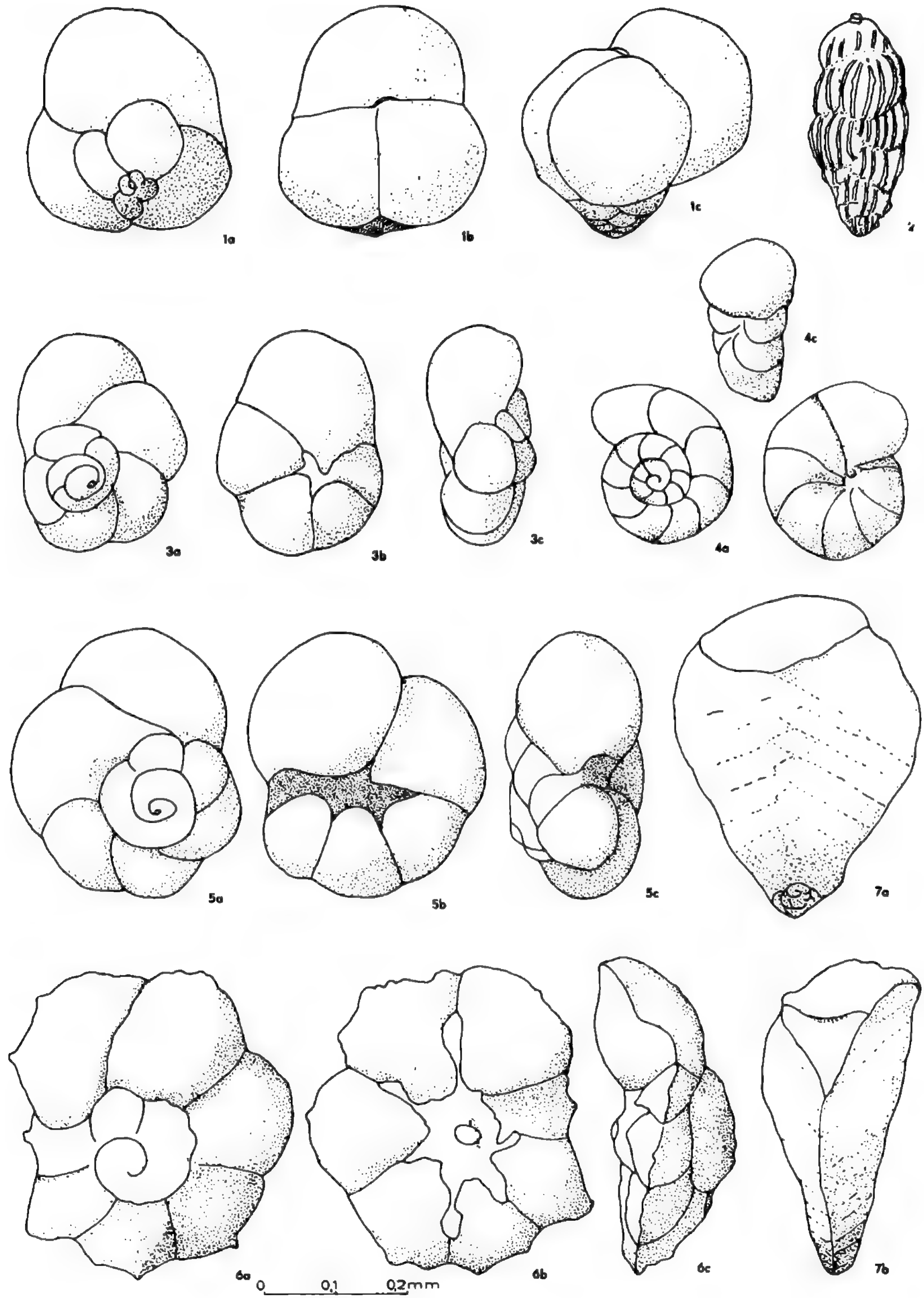

1a
1b
1c
2
4c
3a
3b
3c
4a
5a
5b
5c
7a
6a
0 0,1 0,2mm
6b
6c
7b

PLATE 24

Fig. 1a-b. - *Chiloguembelina trinitatensis* (Cushman & Renz). Tashkurgan section, lev. 61 AD-59/6. Lower Eocene. a: side view; b: edge view. . . . . . p. 135

» 2a-c. - *Pseudohastigerina wilcoxensis* (Cushman & Ponton). Tashkurgan section, lev. 61 AD-59/6. Lower Eocene. . . . . p. 136

» 3a-c. - *Globigerina* cf. *prolata* Bolli. Tashkurgan section, lev. 61 AD-59/6. Lower Eocene. p. 142

» 4a-c. - *Globorotalia traubi* Gohrbandt. Tashkurgan section, lev. 61 AD-59/6. Lower Eocene. . . . . p. 139

» 5a-c. - *Globorotalia* aff. *opima nana* Bolli. Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. . . . . p. 137

» 6a-c. - *Globigerina pseudoeocaena pseudoeocaena* Subbotina. Tashkurgan section, lev. 61 AD-59/6. Lower Eocene. . . . . p. 143

» 7a 8c. - *Globorotalia ehrenbergi* Bolli. Ambar Koh section, lev. 61 AE-89/2. Middle Paleocene. . . . . p. 136

» 9a-c. - *Globorotalia rotundimarginata* (Subbotina). Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. . . . . p. 139

» 10a-c. - *Globorotalia quadratoseptata* (Davidson & Morozova). Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. . . . . p. 138

» 11a-c. - *Globorotalia* aff. *rotundimarginata* (Subbotina). Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. . . . . p. 139

a = spiral view
b = umbilical view
c = side view
All figures × 110.

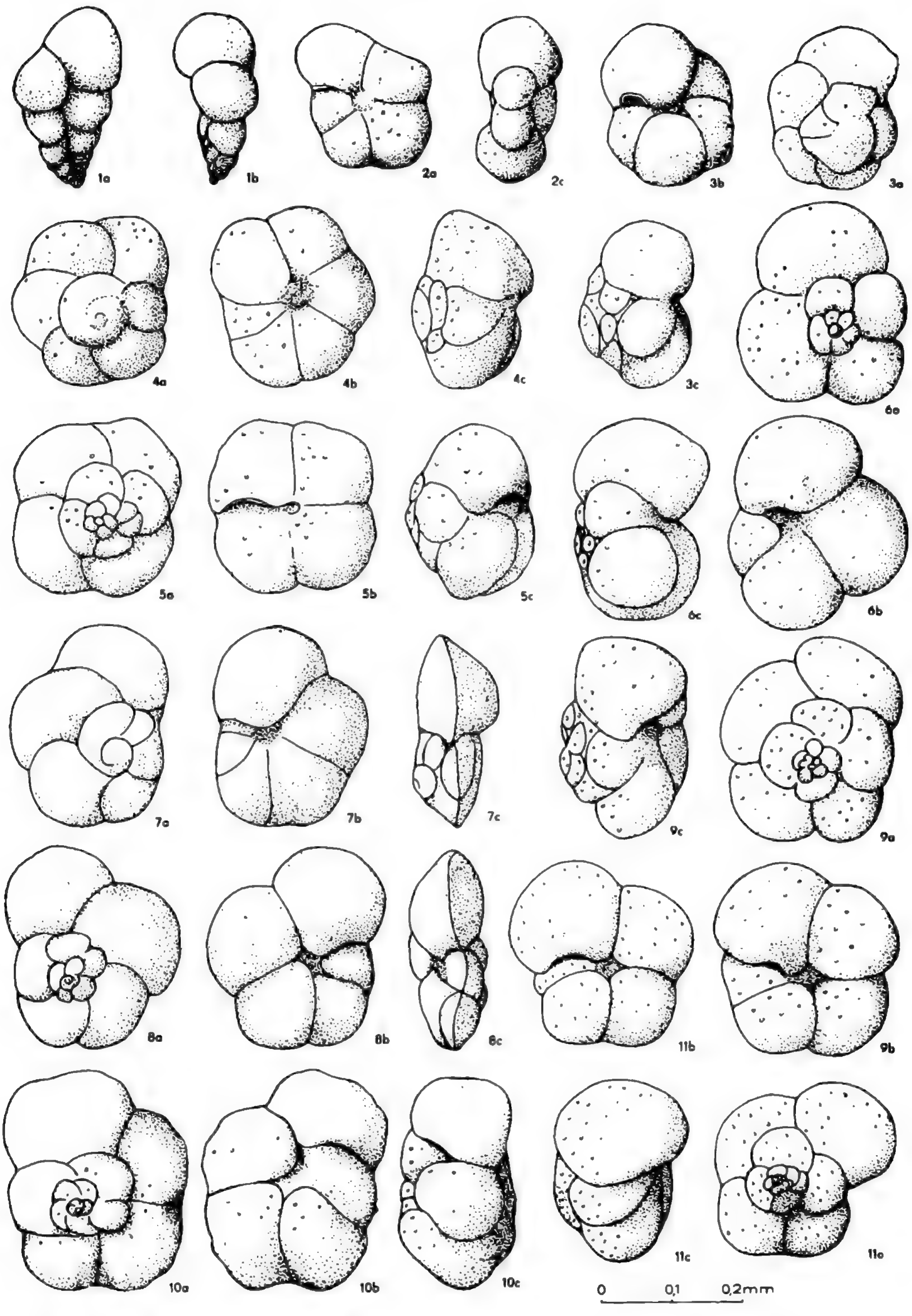

1a
1b
2a
2c
3b
3a
4a
4b
4c
3c
6a
5a
5b
5c
6c
6b
7a
7b
7c
9c
9a
8a
8b
8c
11b
9b
10a
10b
10c
11c
11a
0
0,1
0,2mm

PLATE 25

Fig. 1a-c. - *Globigerina officinalis* Subbotina. Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. p. 142

» 2a-c. - *Globigerina tarchanensis* Subbotina & Khutsieva. Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. . . . . p. 145

» 3a-c. - *Globigerina mckannai* White. Barfaq section, lev. 61 AE-100/3. Middle-Upper Paleocene. . . . . p. 140

» 4a-b. - *Globigerina triloculinoides* Plummer. Ambar Koh section, lev. 61 AE-89/2. Middle Paleocene. p. 145

» 5a-c. - *Globigerina microsphaerica* (Morozova). Ambar Koh section, lev. 61 AE-89/2. Middle Paleocene. p. 141

» 6a-c. - *Globigerina officinalis* Subbotina. Tashkurgan section, lev. 61 AD-59/3. Middle-Upper Eocene. p. 142

» 7a-8c. - *Globigerina falsospiralis* (Davidson & Morozova). Tashkurgan section, lev. 61 AD-59/6. Lower Eocene. . . . . p. 140

» 9a-c. - *Globigerina* aff. *spiralis* Bolli. Ambar Koh section, lev. 61 AE-89/2. Middle Paleocene. . . . . p. 144

» 10b. - *Globigerina spiralis* Bolli. Ambar Koh section, lev. 61 AE-89/2. Middle Paleocene. . . . . p. 144

a = spiral view
b = umbilical view
c = side view
All figures × 110.

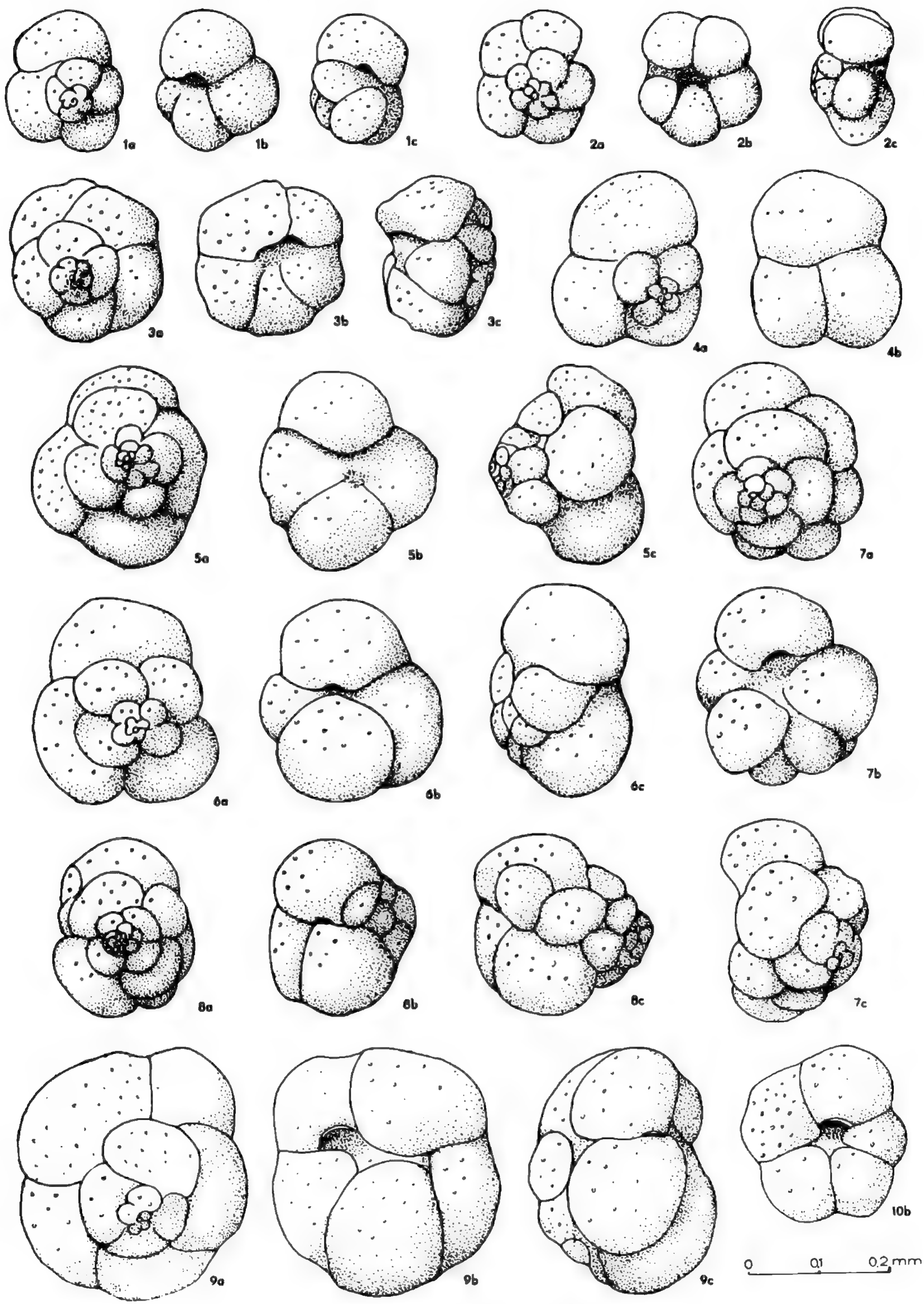

1a
1b
1c
2a
2b
2c
3a
3b
3c
4a
4b
5a
5b
5c
7a
6a
6b
6c
7b
8a
8b
8c
7c
9a
9b
9c
10b
0 0.1 0.2 mm

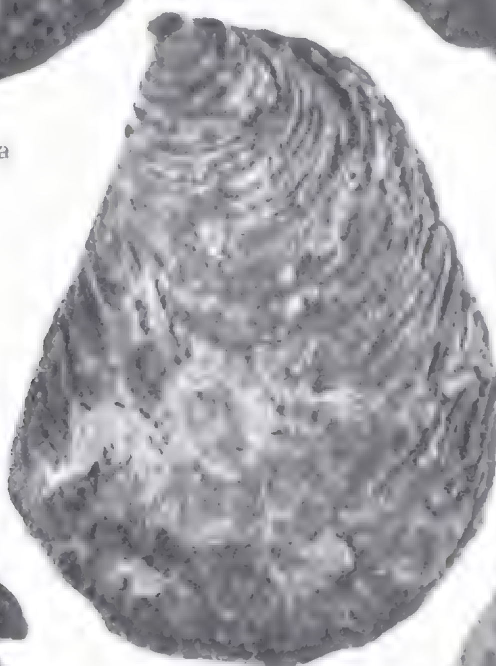
PLATE 26

Amphidonte galeata galeata (Romanovskiy) (p. 180)

Fig. 1a-b. - Exterior and interior of the left valve. Shiboglu Kotal. × 0.65.
» 2. - Exterior of the right valve. Shiboglu Kotal. × 0.65.
» 3. - Exterior of the left valve. Shiboglu Kotal. × 0.65.
» 4. - Exterior of the left valve. Shiboglu Kotal. × 0.65.

1 a

1 b



2

4

3

PLATE 27

Fig. 1. - *Amphidonte galeata rotula* (Vialov). Shiboglu Kotal. Exterior of the left valve. × 0.60. . . . . p. 182

» 2. - *Amphidonte galeata rotula* (Vialov). Shiboglu Kotal. Exterior of the right valve. × 0.65.

» 3a-b. - *Fatina (Fatina) beldersaiensis beldersaiensis* (Gorizdro, partim Vialov). Tashkurgan. Exterior and interior of the left valve. × 1. . . . . p. 184

» 4a-b. - *Fatina (Fatina) beldersaiensis beldersaiensis* (Gorizdro, partim Vialov). Hugi Jangal. Exterior and interior of the left valve. × 1.

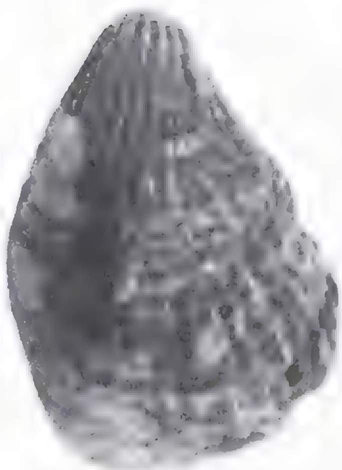
» 5. - *Fatina (Fatina) beldersaiensis beldersaiensis* (Gorizdro, partim Vialov). Ambar Koh. Exterior of the left valve. × 1.

1

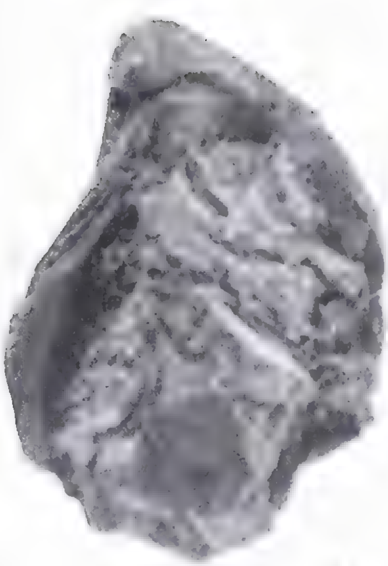
2

3 a

4 a



5



3 b

4 b

PLATE 28

Fig. 1. - *Fatina (Fatina) boehmi boehmi* Vialov. Ambar Koh. Exterior of the left valve. × 1. . . . . p. 186

» 2a-b. - *Fatina (Fatina) beldersaiensis romanowskii* (Böhm). Ambar Koh. Interior and exterior of the left valve. × 1. . . . . p. 185

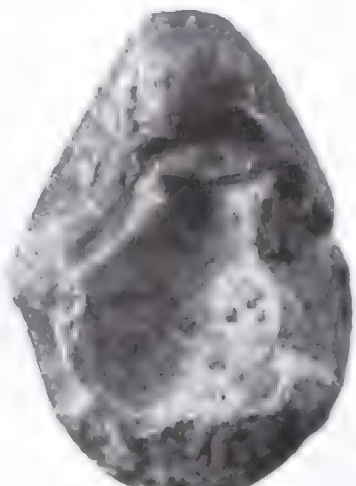
» 3. - *Fatina (Fatina) beldersaiensis romanowskii* (Böhm). Hugi Jangal. Exterior of the left valve. × 1.

» 4. - *Fatina (Fatina) beldersaiensis romanowskii* (Böhm). Tashkurgan. Interior of the left valve. × 1.

» 5. - *Fatina (Fatina) beldersaiensis romanowskii* (Böhm). Ambar Koh. Exterior of the left valve. × 1.

1

2 a



4

3

5

2 b

PLATE 29

Fig. 1a-b. - *Fatina* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov). Ambar Koh. Exterior and interior of the left valve. × 1. . . . . p. 188

» 2. - *Fatina* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov). Ambar Koh. Exterior of the right valve. × 1.

» 3. - *Fatina* (*Sokolowia*) *esterhazyi buhsei* (Grewingk). Ambar Koh. Exterior of the left valve. × 1. . . . . p. 190

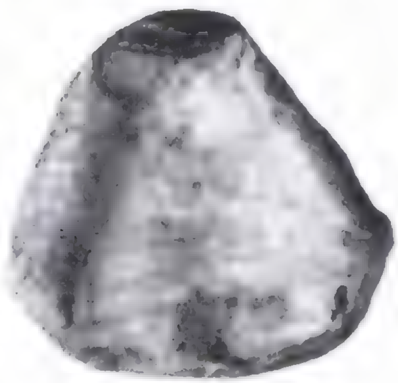
» 4a-b. - *Fatina* (*Sokolowia*) *esterhazyi buhsei* (Grewingk). Ambar Koh. Exterior and interior of the right valve. × 1.

» 5. - *Fatina* (*Fatina*) *boehmi transita* Vialov. Tashkurgan. Exterior of the left valve. × 0.65. . . . . p. 187

1 a

3

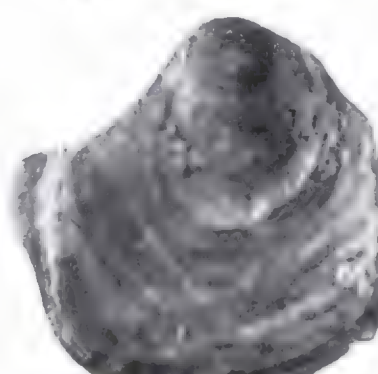
4 a



4 b

5

1 b



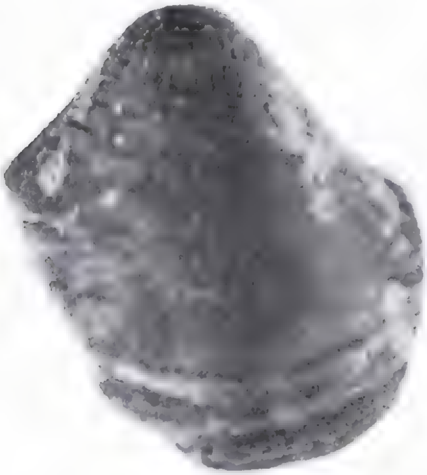
2

PLATE 30

Fig. 1. - *Fatina* (*Sokolowia*) *esterhazyi esterhazyi* (Pavay, partim Vialov). Ambar Koh. Exterior of the left valve. × 1. . . . . p. 188

» 2a-b. - ? *Fatina* (*Sokolowia*) *nuda nuda* Vialov. Tashkurgan. Exterior and interior of the left valve. × 1. . . . . p. 190

» 3. - *Gryphaea* (*Gryphaea*) *smirnowi* Romanovskiy. Ambar Koh. Exterior of the left valve. × 1. . . . . p. 194



1

2 a

2 b

3

PLATE 31

Fig. 1. - *Gryphaea (Gryphaea) latipyga* Vialov. Tashkurgan. Exterior of the left valve. × 0.65. . . . . p. 193

» 2a-b. - *Gryphaea (Gryphaea) latipyga* Vialov. Tashkurgan. Exterior and interior of the left valve. × 0.65.

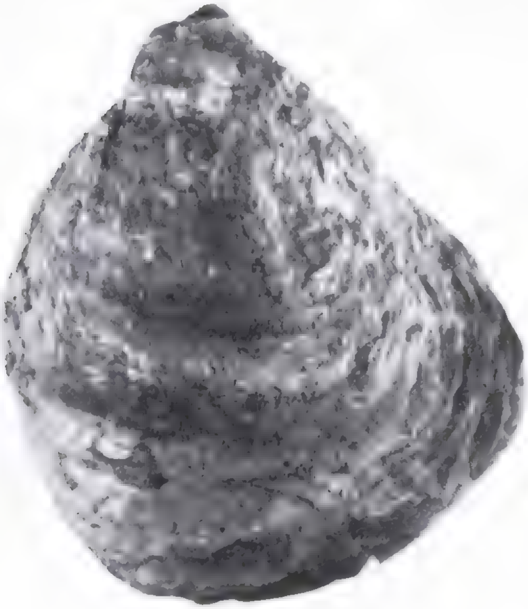
» 3. - *Gryphaea (Phygraea) tournali* (Doncieux). Tashkurgan. Exterior of the left valve. × 0.65. . . . . p. 195

» 4. - *Gryphaea (Ferganea) sewerzowi* Romanovskiy. Ambar Koh. Interior of the left valve. × 1. . . . . p. 192

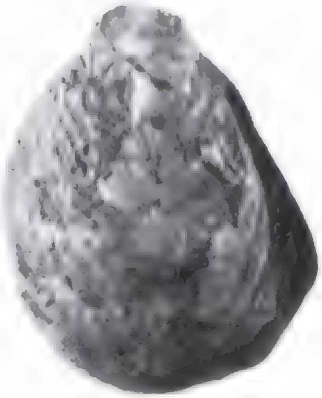
» 5. - *Gryphaea (Ferganea) sewerzowi* Romanovskiy. Ambar Koh. Exterior of the left valve. × 1.

» 6a-b. - *Liostrea (Kokanostrea) kokanensis* (Sokolow). Ambar Koh. Exterior and interior of the left valve. × 1. . . . . p. 196

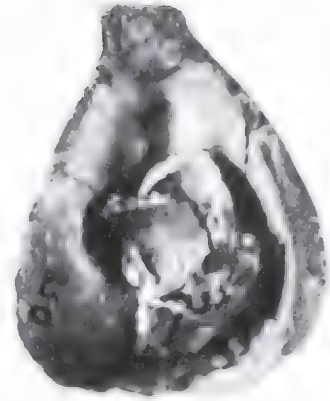
» 7. - *Liostrea (Kokanostrea) kokanensis* (Sokolow). Ambar Koh. Exterior of the left valve. × 1.



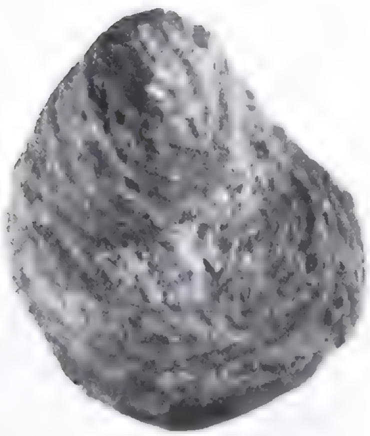
1



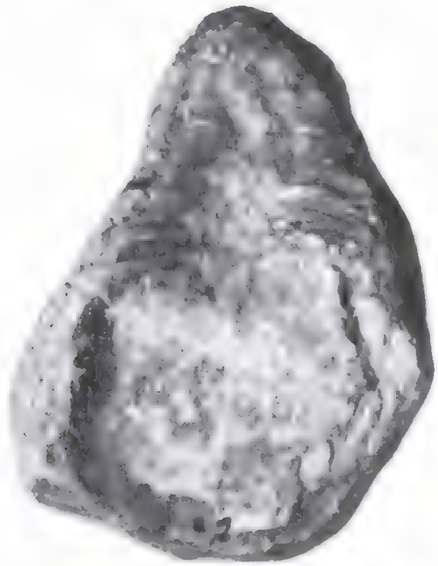
2 a



2 b



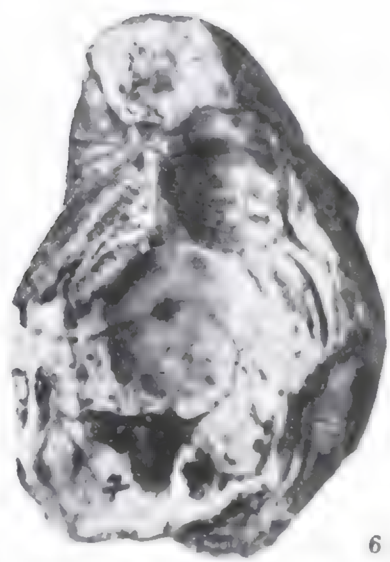
3



4

5

6 a



6 b

7

PLATE 32

Fig. 1. - *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes. Ambar Koh. Exterior of the left valve. × 1. . . . . p. 198

» 2. - *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes. Ambar Koh. Exterior of the left valve. × 1.

» 3a-b. - *Ostrea* (*Cymbulostrea*) *multicostata* Deshayes. Shiboglu Kotal. Exterior of the left and right valves. × 1.

» 4a-d. - *Ostrea* (*Flemingostrea*) *schurabica* Vialov. Shiboglu Kotal. Exterior and interior of the left and right valves. × 1.15. . . . . p. 200

» 5a-b. - *Ostrea* (*Turkostrea*) *khaudaguensis* Vialov. Ambar Koh. Exterior and side views of the left valve. × 1. . . . . p. 205


1
2
3 a
3 b
4 a
4 b
4 c
4 d
5 a
5 b

PLATE 33

Fig. 1a-b. - *Ostrea* (*Solidostrea*) *hemiglobosa* Romanovskiy. Tashkurgan. Exterior and interior of the right valve. × 0.65. . . . . p. 201

» 2a-b. - *Ostrea* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy. Ambar Koh. Exterior and interior of the right valve. × 1. . . . . p. 207

» 3. - *Ostrea* (*Turkostrea*) *afghanica* Vialov. Shiboglu Kotal. Exterior of the left valve. × 1. . . . . p. 202

» 4. - *Ostrea* (*Turkostrea*) *afghanica* Vialov. Shiboglu Kotal. Exterior of the left valve. × 1.

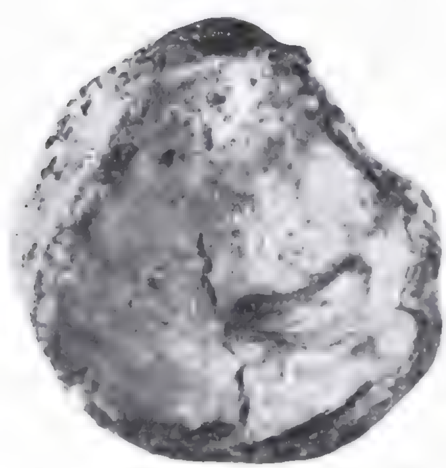
1 a

2 a

3

4

1 b



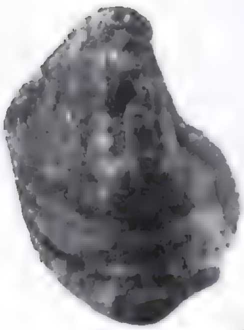
2 b

PLATE 34

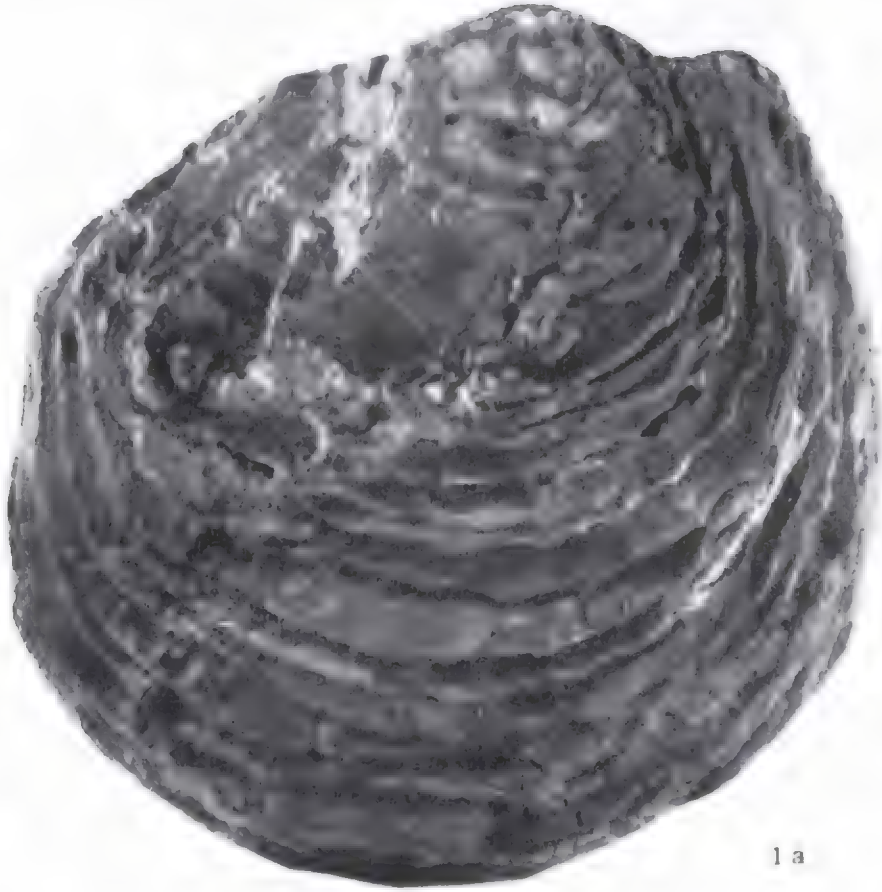
Fig. 1a-b. - *Ostrea* (*Solidostrea*) *hemiglobosa* Romanovskiy. Tashkurgan. Exterior and interior of the left valve. × 0.65. . . . . p. 201

» 2. - *Ostrea* (*Turkostrea*) *cizancourti* Cox. Ambar Koh. Exterior of the left valve. × 1. p. 204

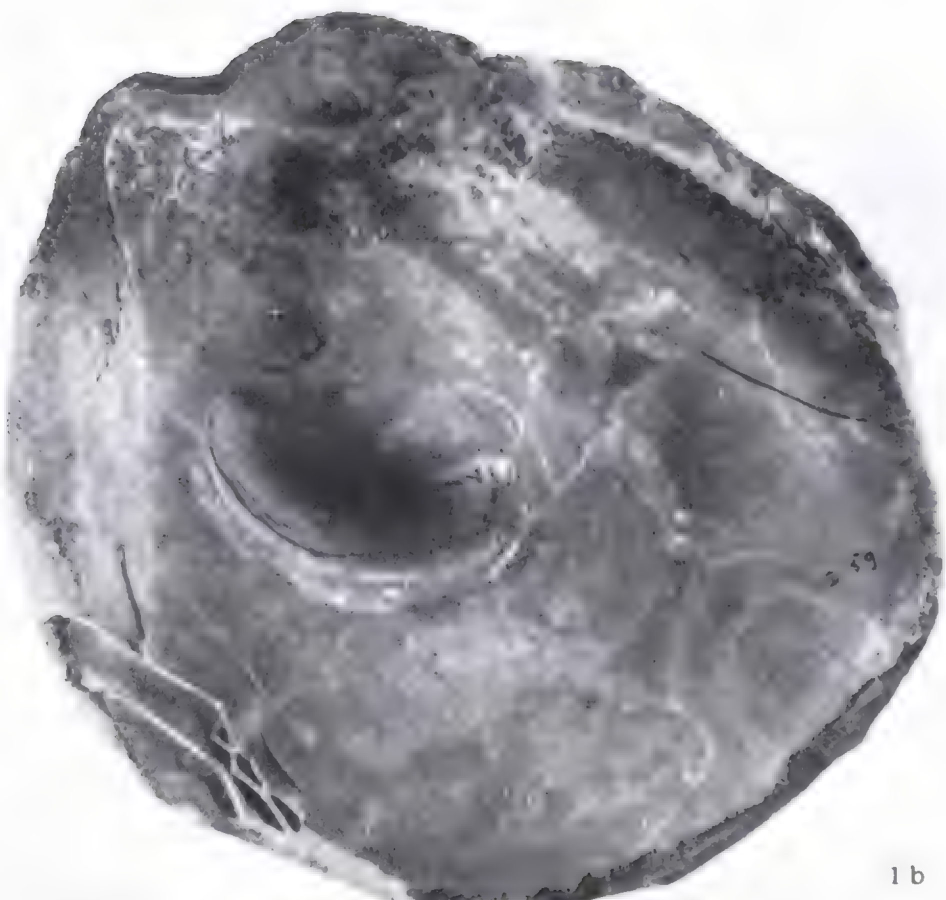
» 3. - *Ostrea* (*Turkostrea*) *turkestanensis turkestanensis* Romanovskiy. Ambar Koh. Exterior of the left valve. × 1. . . . . p. 207



2



1 a



1 b

3

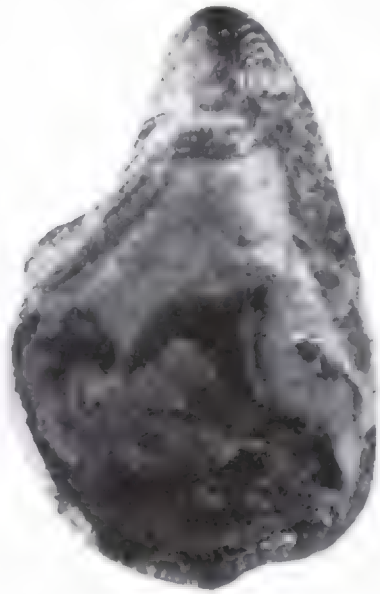
PLATE 35

Fig. 1a-c. - *Ostrea (Turkostrea) cizancourti* Cox. Ambar Koh. Exterior, interior and side of the left valve. × 1. . . . . p. 204

» 2. - *Ostrea (Turkostrea) turkestanensis turkestanensis* Romanovskiy. Ambar Koh. Exterior of the left valve. × 1. . . . . p. 207

» 3a-b. - *Ostrea (Turkostrea) turkestanensis turkestanensis* Romanovskiy. Ambar Koh. Exterior and side of the left valve. × 1.

1 a

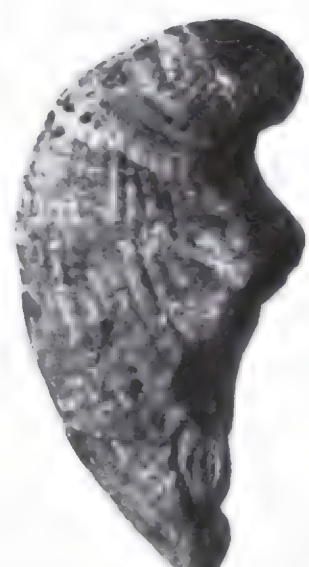


1 b

1 c

2

3 a



3 b

PLATE 36

Fig. 1. - *Ostrea* (*Turkostrea*) *turkestanensis alaica* Vialov. Ambar Koh. Exterior of the left valve. × 1. . . . . p. 209

» 2. - *Ostrea* (*Turkostrea*) *turkestanensis alaica* Vialov. Ambar Koh. Interior of the left valve. × 1.

» 3. - *Ostrea* (*Turkostrea*) *turkestanensis alaica* Vialov. Ambar Koh. Side of the left valve. × 1.

» 4. - *Ostrea* (*Turkostrea*) *turkestanensis baissunensis* Böhm. Shiboglu Kotal. Exterior of the left valve. × 1. p. 210

» 5. - *Ostrea* (*Turkostrea*) *turkestanensis baissunensis* Böhm. Shiboglu Kotal. Exterior of the left valve. × 1.

» 6. - *Ostrea* (*Turkostrea*) *turkestanensis baissunensis* Böhm. Shiboglu Kotal. Exterior of the left valve. × 1.

» 7a-b. - *Ostrea* (*Turkostrea*) *turkestanensis baissunensis* Böhm. Shiboglu Kotal. Exterior and side of the left valve. × 0.65.


1
2
3
4
5
6
7 a
7 b

PLATE 37

Fig. 1a-b. - *Ostrea* (*Turkostrea*) *turkestanensis borgalensis* Vialov. Ambar Koh. Exterior and interior of the left valve. × 1. . . . . p. 212

» 2a-b. - *Ostrea* (*Turkostrea*) *turkestanensis borgalensis* Vialov. Ambar Koh. Exterior and interior of the left valve. × 1.

» 3. - *Ostrea* sp. ind. Vialov. Ambar Koh. I specimen. Exterior of the left valve. × 1. p. 213

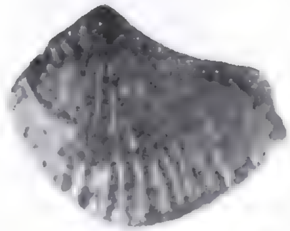
» 4. - *Ostrea* sp. ind. Vialov. Ambar Koh. II specimen. Exterior of the left valve. × 1.

» 5. - *Ostrea* sp. ind. Vialov. Ambar Koh. III specimen. Interior of the left valve. × 1.

» 6. - *Diplodonta cycloidea* (Bellardi). Ali Abad. Internal bivalve mould. Right valve. × 1.15. . . . . p. 221

» 7. - *Diplodonta cycloidea* (Bellardi). Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.15.

1 a

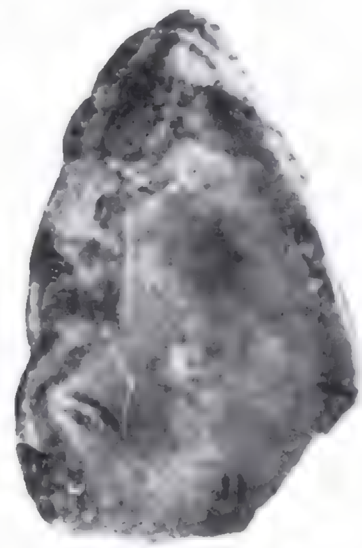


3

1 b

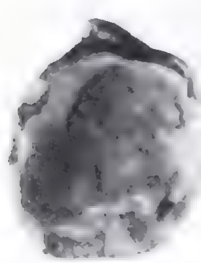
4

2 a

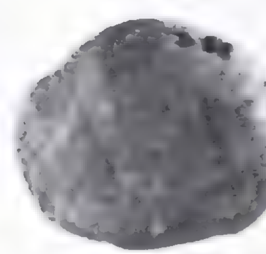


2 b

6



5



7

PLATE 38

Fig. 1a-b. - *Cavilucina* (*Pegophysema*) *thebaica* (Zittel). Shiboglu Kotal. Internal bivalve mould. Exterior and dorsal views. × 1.2. . . . . p. 215

» 2. - *Cavilucina* (*Pegophysema*) *thebaica* (Zittel). Shiboglu Kotal. Internal bivalve mould. Right valve. × 1.2.

» 3. - *Pterolucina* cf. *menardi* (Deshayes). Shiboglu Kotal. Internal bivalve mould. Right valve. × 1.2 . . . . p. 216

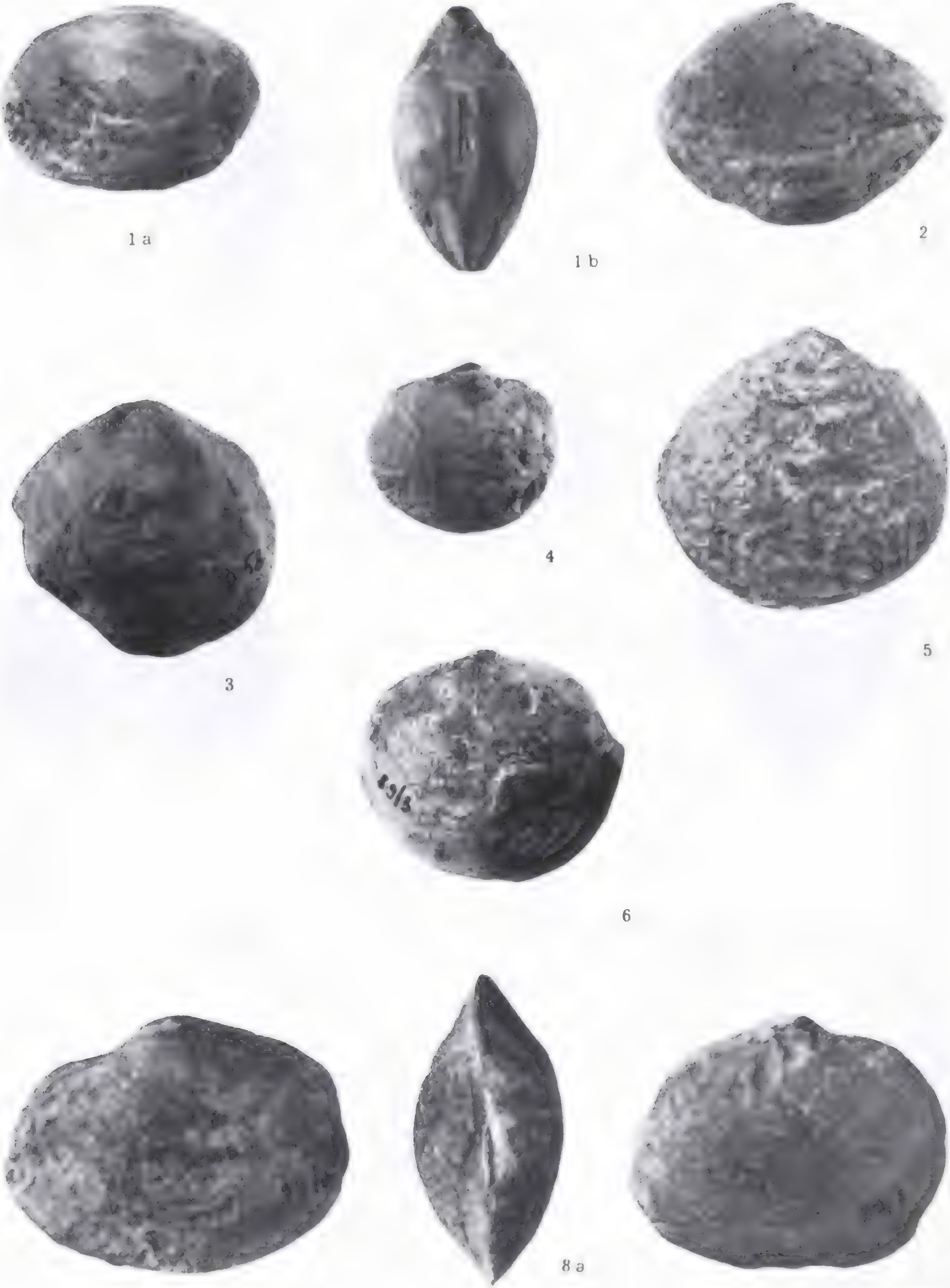
» 4. - *Diplodonta cycloidea* (Bellardi). Ali Abad. Internal bivalve mould. Right valve. × 1.3. . . . . p. 221

» 5. - *Pterolucina* cf. *mokattamensis* (Oppenheim). Ambar Koh. Internal bivalve mould. Left valve. × 1. p. 217

» 6. - *Pterolucina pharaonis pharaonis* (Bellardi). Ambar Koh. Internal bivalve mould. Right valve. × 1. . . . . p. 218

» 7. - *Pterolucina pharaonis bialata* (Bellardi). Ambar Koh. Internal bivalve mould. Left valve. × 1. p. 220

» 8a-b. - *Pterolucina pharaonis bialata* (Bellardi). Ambar Koh. Internal bivalve mould. Dorsal and exterior views. × 1.



1 a 1 b 2

3 4 5

6

7 8 a 8 b

PLATE 40

Fig. 1. - *Arctica transversa* (d'Archiac). Ambar Koh. Internal bivalve mould. Left valve. × 1. . . . . p. 227

» 2a-b. - *Arctica transversa* (d'Archiac). Ali Abad. Internal bivalve mould. Exterior and postero-dorsal views. × 1.

» 3a-b. - *Venus* sp. ind. aff. *matheroni* Coquand. Shiboglu Kotal. Internal bivalve mould. Exterior and posterior views. × 1.15 . . . . p. 230

» 4. - *Venus everesti* d'Archiac. Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.15. . . . . p. 229

» 5. - *Venus everesti* d'Archiac. Tashkurgan. Internal bivalve mould. Right valve. × 1.15.

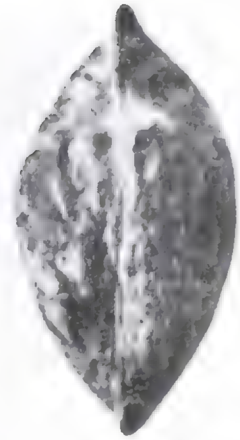
» 6. - *Venus everesti* d'Archiac. Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.15.

» 7a-b. - *Venus* cf. *gumberensis* d'Archiac. Shiboglu Kotal. Internal bivalve mould. Exterior and postero-dorsal views. × 1.15. . . . . p. 231

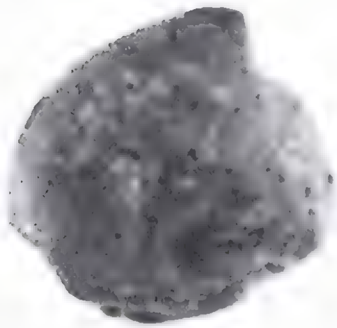
» 8. - *Corbicula veneriformis* (Deshayes). Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.20. p. 228

1

2 a

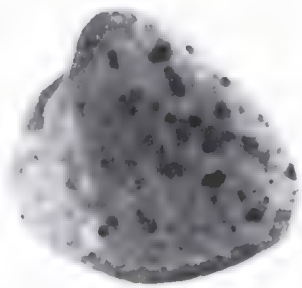


2 b

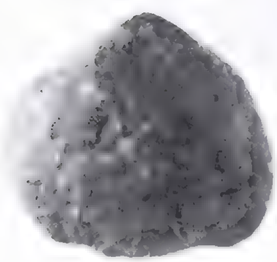


3 a

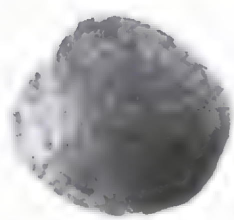
3 b



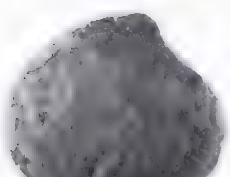
8



4

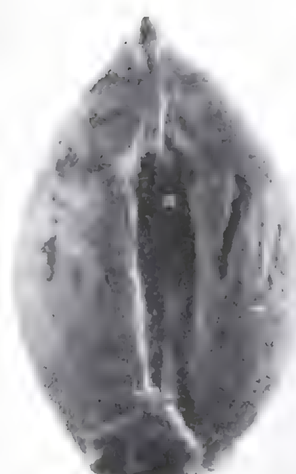


6



5

7 a



7 b

PLATE 39

Fig. 1a-b. - *Cardium halaense* d'Archiac. Ali Abad. Internal bivalve mould. Exterior and dorsal views. × 1.5. p. 223

» 2a-b. - *Cardium kanleanum* Cotter. Ambar Koh. Internal bivalve mould. Exterior and posterior views. × 1. p. 225

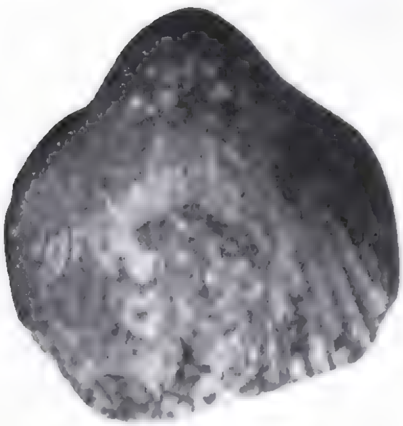
» 3a-b. - *Cardium kanleanum* Cotter. Ali Abad. Internal bivalve mould. Exterior and posterior views. × 1.

» 4a-b. - *Arctica subathooensis* (d'Archiac). Ali Abad. Internal bivalve mould. Exterior and postero-dorsal views. × 1.20. . . . . p. 226

1 a

1 b

4 a



2 a

2 b

4 b

3 a

3 b

PLATE 40

Fig. 1. - *Arctica transversa* (d'Archiac). Ambar Koh. Internal bivalve mould. Left valve. × 1. . . . . p. 227

» 2a-b. - *Arctica transversa* (d'Archiac). Ali Abad. Internal bivalve mould. Exterior and postero-dorsal views. × 1.

» 3a-b. - *Venus* sp. ind. aff. *matheroni* Coquand. Shiboglu Kotal. Internal bivalve mould. Exterior and posterior views. × 1.15 . . . . p. 230

» 4. - *Venus everesti* d'Archiac. Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.15. . . . . p. 229

» 5. - *Venus everesti* d'Archiac. Tashkurgan. Internal bivalve mould. Right valve. × 1.15.

» 6. - *Venus everesti* d'Archiac. Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.15.

» 7a-b. - *Venus* cf. *gumberensis* d'Archiac. Shiboglu Kotal. Internal bivalve mould. Exterior and postero-dorsal views. × 1.15. . . . . p. 231

» 8. - *Corbicula veneriformis* (Deshayes). Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.20. . . . . p. 228

1 2 a 2 b 3 a 3 b 8 4 6 5 7 a 7 b

PLATE 41

Fig. 1. - *Meretrix transversa* (Sowerby). Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.20. . . . . p. 235

» 2a-b. - *Meretrix transversa* (Sowerby). Shiboglu Kotal. Internal bivalve mould. Exterior and posterior views. × 1.20.

» 3. - *Meretrix incrassata* (Sowerby). Shiboglu Kotal. Internal bivalve mould. Left valve. × 1.15. . . . . p. 233

» 4. - *Meretrix aegyptiaca* (Mayer-Eymar). Shiboglu Kotal. Internal bivalve mould. Right valve. × 1.20. p. 232

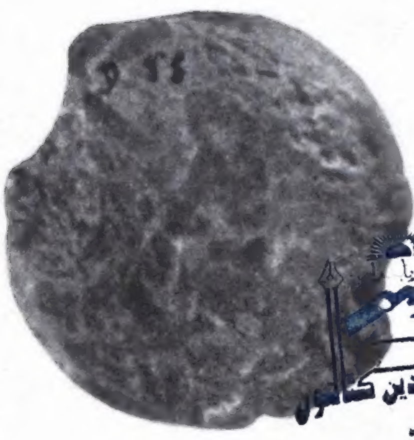
» 5. - *Meretrix semisulcata* (Lamarck). Ambar Koh. Internal bivalve mould. Left valve. × 1. . . . . p. 234

» 6a-b. - *Meretrix semisulcata* (Lamarck). Ambar Koh. Internal bivalve mould. Dorsal and exterior views. × 1.

1

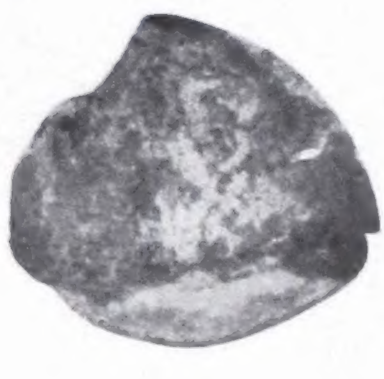
2 a

2 b

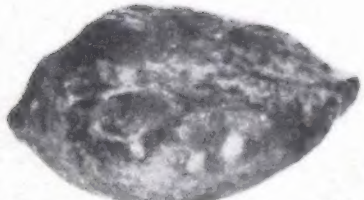


3

4



5



6 a

6 b